TWIN DISC
INCORPORATED

Service Manual

Marine Transmission

Components:
MG-5222DC

Document Number: 1020538

NOTICE

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Document Number
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January, 2002

Marine Transmission Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY
COMMERCIAL MARINE TRANSMISSION

A. Twin Disc, Incorporated warrants all assembled products and parts, (except component products or parts on which written warranties issued by the respective manufacturers thereof are furnished to the original customer, as to which Twin Disc, Incorporated makes no warranty and assumes no liability) against defective materials or workmanship *for a period of twenty-four (24) months from the date of shipment by Twin Disc, Incorporated to original customer, but not to exceed twelve (12) months of service, whichever occurs first.* **This is the only warranty made by Twin Disc, Incorporated and is in lieu of any and all other warranties, express or implied, including the warranties of merchantability or fitness for a particular purpose and no other warranties are implied or intended to be given by Twin Disc, Incorporated.** The original customer does not rely upon any tests or inspections by Twin Disc, Incorporated or on Twin Disc, Incorporated*s application engineering.

B. **The exclusive remedy provided by Twin Disc, Incorporated whether arising out of warranty within the applicable warranty period as specified, or otherwise (including tort liability), shall at the sole option of Twin Disc, Incorporated be either the repair or replacement of any Twin Disc, Incorporated part or product found by Twin Disc, Incorporated to be defective and the labor to perform that work and to remove and reinstall (or equivalent credit). In this context, labor is defined as the flat rate labor hours established by Twin Disc, Incorporated in the published Twin Disc Flat Rate Schedule, required to remove, disassemble, inspect, repair, reassemble, reinstall and test the Twin Disc, Incorporated product only. Authorized reasonable travel and living expenses will be considered for payment. Under no circumstances, including a failure of the exclusive remedy, shall Twin Disc, Incorporated be liable for economic loss, consequential, incidental or punitive damages.** The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in-warranty repair.

2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.

3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.

4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.

5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.

6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer*s and subsequent purchaser*s employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.

E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no-charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE

(Hourly Labor Rate Must be Acceptable to Twin Disc, Incorporated.)

COMMERCIAL MARINE TRANSMISSIONS - ALL RATIOS:

MODEL SERIES	R&R	UNIT REBUILD	CLUTCH REPAIR (BOTH PACKS)
MG 502, MG 5010, MG5011, MG5005A MG5015A	10.0	8.0	-
MG 506, MG5061, MG 5050, MG5055A	10.0	11.0	-
MG 507, MG 5081, MG5085, MG5090,	10.0	12.0	-
MG 5091	10.0	12.0	4.0
MG5112,MG5113	10.0	17.0	-
MG 509, MG 5111, MG5114	10.0	17.0	4.0
MG5114A, MG5114RV	10.0	17.0	-
MG 514C, MG514M, MG5141, MG514CHP	10.0	25.0	6.0
MG 516, MG 5161	10.0	28.0	8.0
MG 518-1	10.0	32.0	10.0
MG520-1, MG 5202, MG5203, MG5204 MG5205	10.0	32.0	10.0
MG 530, MG530M, MG5301	12.0	32.0	16.0
MG 540	20.0	62.0	20.0
MG5600	20.0	62.0	20.0
MG6000	10.0	32.0	10.0
MGN80, MGN232, MGN233, MGN272, MGN273, MGN332, MGN334, MGN335, MGN432, MGN433, MGN472, MGN493	10.0	32.0	10.0
MGN650, MGN800,MGN1000,MGN1400, MGN1600	20.0	62.0	40.0
PUMP - ALL MODELS	1.0	-	
VALVE - ALL MODELS:	1.0	.5	

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Introduction

General Information

This publication provides service information for the Twin Disc model MG-5222DC marine transmission. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA..

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unaccepted maintenance/working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in the Marine Transmission Operator's Manual, 1016313, regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment.

Towing

⚠ WARNING

Under the conditions described below, the prop shaft must be locked in place to prevent backdriving. Failure to do this can damage the marine transmission due to the lack of component lubrication.

Backdriving (also called windmilling) occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller, which, in turn, rotates the components in the marine transmission. During backdriving conditions, the transmission does not receive proper lubrication.

Conditions where backdriving may occur:

- ❑ Vessel is being towed.
- ❑ One or more engines on a multiple-transmission vessel are shut down while under way.
- ❑ Sailboat under sail with auxiliary engine shut down.
- ❑ Vessel tied up or docked in a heavy current.

The following solutions are applicable for all MG-5222DC transmissions if any of the above conditions are present:

- ❑ Lock the propeller shaft to prevent rotation.
- ❑ Add an electric-driven auxiliary oil pump into the lubrication circuit.

Refer to the hydraulic system prints for more details on auxiliary pump specifications for the applicable transmission, or contact your Twin Disc Authorized Distributor.

Ordering Parts and Obtaining Services

⚠ WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts from the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department, Twin Disc, Incorporated, Racine, Wisconsin 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

Nameplate

The nameplate identifies the model, bill of material (BOM) and the serial number of the unit. These numbers are necessary to identify the correct parts for your transmission.

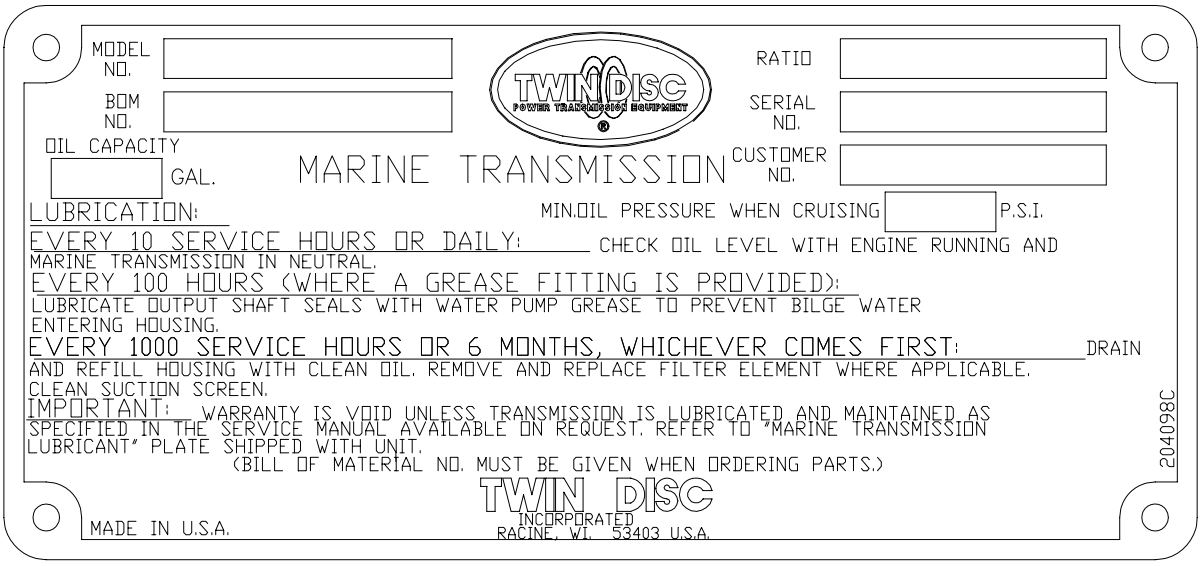

MODEL NO.
BOM NO.
OIL CAPACITY
GAL.
TWIN DISC
POWER TRANSMISSION EQUIPMENT
MARINE TRANSMISSION
RATIO
SERIAL NO.
CUSTOMER NO.
LUBRICATION:
MIN. OIL PRESSURE WHEN CRUISING
P.S.I.
EVERY 10 SERVICE HOURS OR DAILY: CHECK OIL LEVEL WITH ENGINE RUNNING AND MARINE TRANSMISSION IN NEUTRAL.
EVERY 100 HOURS (WHERE A GREASE FITTING IS PROVIDED):
LUBRICATE OUTPUT SHAFT SEALS WITH WATER PUMP GREASE TO PREVENT BILGE WATER ENTERING HOUSING.
EVERY 1000 SERVICE HOURS OR 6 MONTHS, WHICHEVER COMES FIRST: DRAIN AND REFILL HOUSING WITH CLEAN OIL. REMOVE AND REPLACE FILTER ELEMENT WHERE APPLICABLE. CLEAN SUCTION SCREEN.
IMPORTANT: WARRANTY IS VOID UNLESS TRANSMISSION IS LUBRICATED AND MAINTAINED AS SPECIFIED IN THE SERVICE MANUAL AVAILABLE ON REQUEST. REFER TO "MARINE TRANSMISSION LUBRICANT" PLATE SHIPPED WITH UNIT.
(BILL OF MATERIAL NO. MUST BE GIVEN WHEN ORDERING PARTS.)
TWIN DISC
INCORPORATED
RACINE, WI. 53403 U.S.A.
MADE IN U.S.A.
204098C

Figure 1. Nameplate for MG-5222DC Marine Transmission

Power Ratings

The MG-5222DC transmission can be operated through either the primary shaft or secondary shaft at its full rated horsepower when driven by a standard right hand rotation engine (counterclockwise flywheel rotation when viewing rear of engine). This series of marine transmissions cannot be driven by a left hand rotation engine. Contact an authorized Twin Disc distributor for more information.

Transmission clutches are hydraulically applied using main oil pressure. All bearings, clutches and gears are lubricated and cooled with low-pressure oil.

Always reference the Bill of Materials (BOM) or Specification number when ordering service parts.

Construction Features

Housings

The MG-5222DC transmission has a one-piece main housing. Front housing sizes in SAE No. 0 and SAE No. 1 sizes are available. A top cover, bearing carrier, and manifold (sealed with gaskets) complete the housing enclosure.

Bearings

The primary and secondary clutch shafts and pinions are supported and located by a combination of straight and tapered roller bearings. Bearing clearances for each clutch shaft and pinion assembly are set by use of a single shim pack at the rear-tapered roller bearing on each shaft. Tapered roller bearings also support the output shaft and have bearing clearance adjusted by use of shims at the bearing carrier.

Oil Pump and Drive

The oil pump is driven by the secondary clutch shaft.

Lubrication Features

The MG-5222DC transmission has a lubrication tube located inside the main housing. The tube extends from the front to the rear of the inside of the housing. The lubrication tube has drilled holes in the tube that spray oil on the transfer gears and the primary and secondary pinions. Bearings and clutches on the primary and secondary shafts are lubricated through drilled passages in the shafts. Output shaft bearings are gravity and splash lubricated.

Suction Strainer

The marine transmission has a serviceable suction strainer located below the oil pump. The strainer is between the sump and the oil pump in the hydraulic circuit. The strainer can be replaced if necessary.

Filter Assembly

A spin-on oil filter is located between the heat exchanger outlet and the selector valve in the hydraulic circuit. The replacement element is Twin Disc part number XB3614. This should be replaced at 1000 hour or six month intervals, whichever comes first.

Gears

All gears are helical, carburized, hardened and ground for smooth quiet operation. All gears are in constant mesh. The primary and secondary transfer gears and the output gear are mounted on keyless tapers.

Flexible Torsional Input Coupling

The purpose of the torsional coupling is to transmit power from the engine to the marine transmission through a rubber or silicone element that will:

- ❑ Dampen torsional vibrations
- ❑ Change the natural frequencies of a system to move critical frequencies out of the operating speed range
- ❑ Accommodate a certain amount of misalignment
- ❑ Absorb shock and reduce noise
- ❑ Minimize gear “rattle”

Several couplings are available from Twin Disc, and are selected based on the customer supplied engine information. Final coupling selection must be confirmed by the packager based on the torque/rpm ratings and the results of the system torsional vibration analysis (TVA), and on engine rotation. Care must be taken when servicing that replacement couplings are matched to this criteria.

Heat Exchanger

The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing raw or fresh water through the heat exchanger. The heat exchanger should be installed in a location convenient to both coolant and marine transmission oil.

Specifications

Maximum operating speed: 2500 rpm

Maximum oil sump temperature: 93° C (200° F)

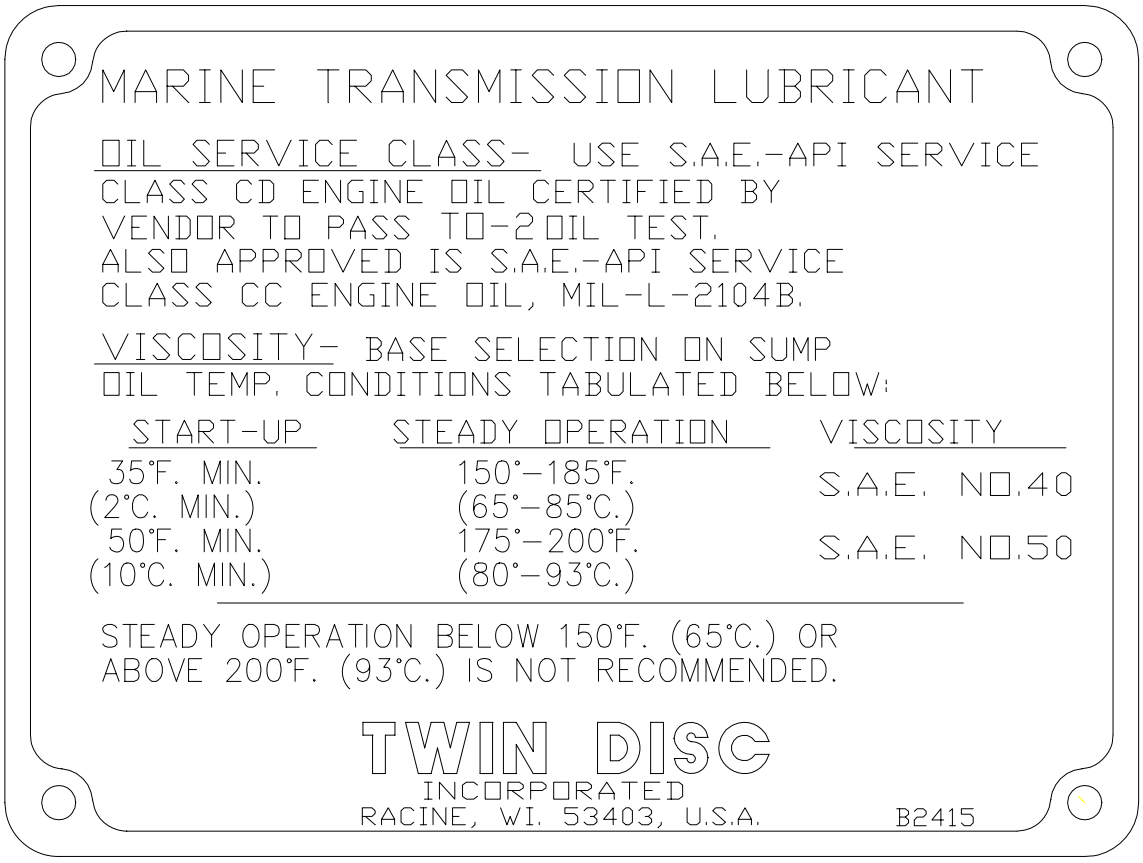
Oil type and viscosity: See data plate below

Oil capacity: 31.4 liters (8.3 gal) plus hoses and heat exchanger

Oil Pump: 88 liters per minute (23.2 GPM) at 2300 RPM

Approximate Dry weight: 1046 kg (2306) lbs.

Oil pressure: See Table 1 for oil pressure specifications. Minimum oil pressure when cruising is 1620 kPa (235 psi).


MARINE TRANSMISSION LUBRICANT
OIL SERVICE CLASS- USE S.A.E.-API SERVICE CLASS CD ENGINE OIL CERTIFIED BY VENDOR TO PASS TO-2 OIL TEST. ALSO APPROVED IS S.A.E.-API SERVICE CLASS CC ENGINE OIL, MIL-L-2104B.
VISCOSITY- BASE SELECTION ON SUMP OIL TEMP. CONDITIONS TABULATED BELOW:
START-UP
STEADY OPERATION
VISCOSITY
35°F. MIN. (2°C. MIN.)
150°-185°F. (65°-85°C.)
S.A.E. NO.40
50°F. MIN. (10°C. MIN.)
175°-200°F. (80°-93°C.)
S.A.E. NO.50
STEADY OPERATION BELOW 150°F. (65°C.) OR ABOVE 200°F. (93°C.) IS NOT RECOMMENDED.
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INCORPORATED
RACINE, WI. 53403, U.S.A.
B2415

Figure 2. Oil Specification Plate

Table 1. MG-5222DC Oil Pressure Specifications

Oil pressure Limits - 1725 kPa (250 psi) rating (235psi minimum pressure when cruising)									
Input Speed	**Shift Position**	**Main Pressure at Valve Inlet**		**Primary Clutch Min.**		**Secondary Clutch Min.**		**Lube**	
		kPa	**psi**	**kPa**	**psi**	**kPa**	**psi**	**kPa**	**psi**
600	Neutral	255-310	37-45	0	0	0	0	34-83	5-12
600	Primary	1586-1793	230-260	1558	226	0	0	14-55	2-8
600	Secondary	1586-1793	230-260	0	0	1558	226	14-55	2-8
1800	Neutral	275-690	40-100	0	0	0	0	214-372	31-54
1800	Primary	1725-1862	250-270	1696	246	0	0	97-234	14-34
1800	Secondary	1725-1862	250-270	0	0	1696	246	97-234	14-34

Note: It is required that lube pressure with primary clutch engaged must equal lube pressure with secondary clutch engaged within 21 kPa (3 psi).

Note: Oil temperature to be in normal operating range.

Optional Equipment

The following optional equipment for use with the model MG-5222DC is available through the nearest authorized Twin Disc distributor.

Optional Trailing Pump

A 115 vac electric powered trailing pump system is available. It is identified as part number 1016473. A drawing is included in the Engineering Drawings.

Power Take-off

A live power take-off pump mount is available in sizes SAE J744 No. 32-4 and SAE J744 No. 38-4.

A hydraulically clutchable PTO is available in sizes SAE J744 No. 32-4 and SAE J744 No. 38-4.

Metric to NPTF Adapter Kit

An adapter kit (K1090) is available to convert the oil drain plug opening, the transmission oil ports to and from the heat exchanger, and the pressure test ports from metric to NPTF threads.

Mounting Brackets

Steel fabricated mounting brackets for rigid mounting are available. They are part number 1016428Y.

Torsional Input Coupling

Several models of torsional input couplings are available, including Vulkan VKE4911S in both 14” and 18” flywheel sizes as well as Centa CF-R in both 14” and 18” flywheel sizes. There is also an optional inertia ring available for use with the Vulkan VKE type couplings

Remote Oil Filter

There is a remote oil filter kit available, BOM K1296

Heat Exchanger

There are two different remote heat exchangers available, M1959AN for use with raw water, and M1959AM for use with fresh (engine jacket) water.

Companion Flange Assembly

The 1002312 companion flange assembly consists of the companion flange as well as the 12 bolts and nuts to secure it to the marine transmission’s output flange

Trolling Valve

The mechanical trolling valve kit for the standard mechanical control valve is K1331.

Two trolling valve kits are available for use with this transmission when equipped with the optional electric control valve, BOM 40588 which is mechanically actuated, and BOM 41063 which is electrically actuated.

Table 2. Gear Advance

Transmission Primary and Secondary Transfer Gear Advance	
Minimum	**Maximum**
2.84mm (.112 in)	3.86mm (.152 in)
Transmission Output Gear Advance	
Minimum	**Maximum**
9.52mm (.375 in)	11.05mm (.435 in)

Table 3. Bearing End Play

Transmission Primary and Secondary Shaft Tapered Roller Bearing Endplay	
Minimum	**Maximum**
0.05 mm (.002 in)	0.15 mm (.006 in)
Transmission Output Shaft Bearing Endplay	
Minimum	**Maximum**
0.05 mm (.002 in)	0.15 mm (.006 in)

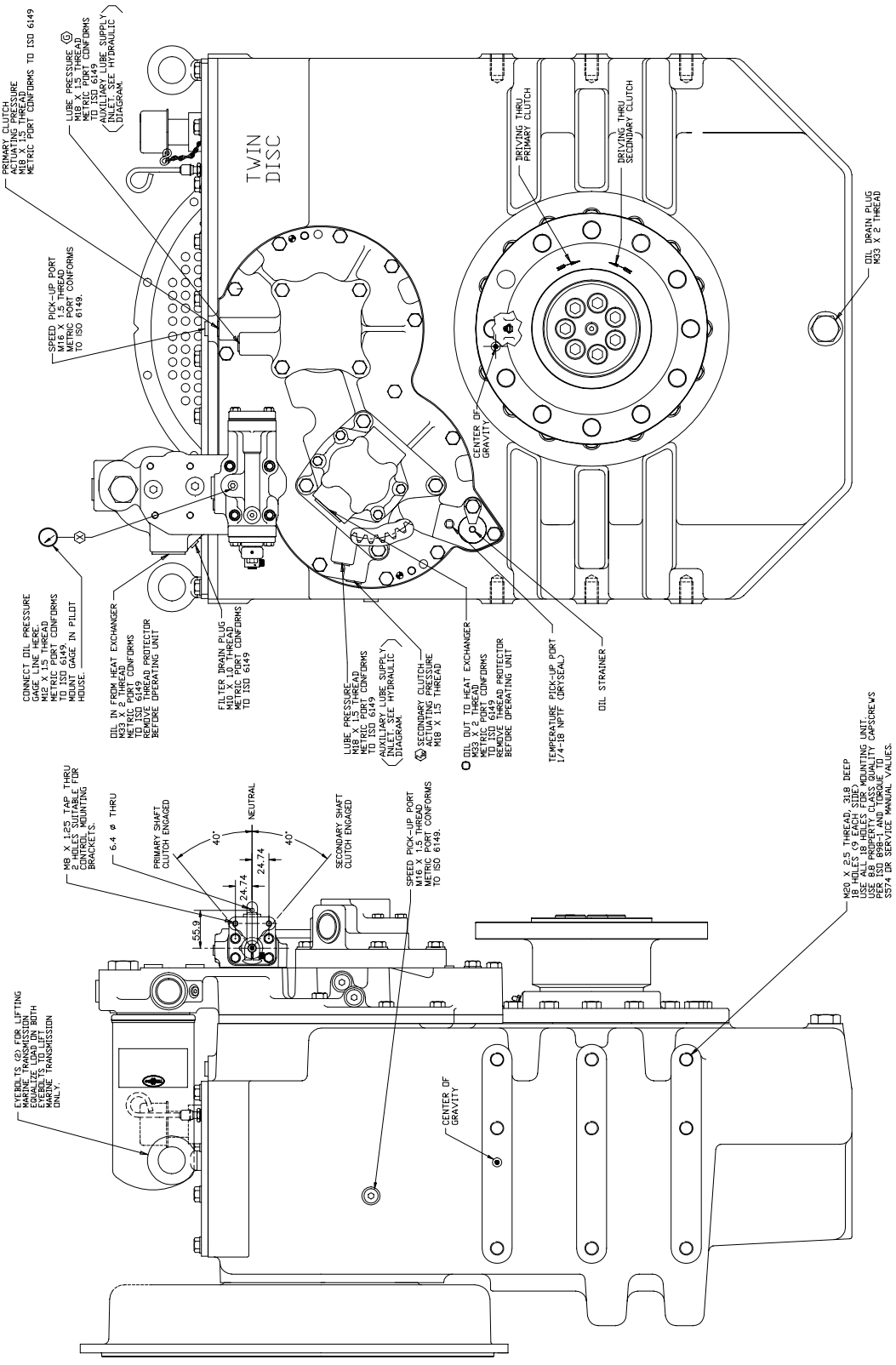

PRIMARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
LUBE PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149 AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
SPEED PICK-UP PORT M16 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149.
TWIN DISC
DRIVING THRU PRIMARY CLUTCH
DRIVING THRU SECONDARY CLUTCH
OIL DRAIN PLUG M33 X 2 THREAD
CENTER OF GRAVITY
CONNECT OIL PRESSURE GAGE LINE HERE. M14 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149. MOUNT GAGE IN PILOT HOUSE.
OIL IN FROM HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE THREAD PROTECTOR BEFORE OPERATING UNIT
FILTER DRAIN PLUG M10 X 1.0 THREAD METRIC PORT CONFORMS TO ISO 6149
LUBE PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
SECONDARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD
OIL OUT TO HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE THREAD PROTECTOR BEFORE OPERATING UNIT
TEMPERATURE PICK-UP PORT 1/4-18 NPTF (DRYSEAL)
OIL STRAINER
M8 X 1.25 TAP THRU 2 HOLES SUITABLE FOR CONTROL MOUNTING BRACKETS:
6.4 ø THRU
PRIMARY SHAFT CLUTCH ENGAGED
NEUTRAL
SECONDARY SHAFT CLUTCH ENGAGED
40°
40°
24.74
24.74
55.9
SPEED PICK-UP PORT M16 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149.
M20 X 2.5 THREAD, 31.8 DEEP 4 HOLES EQUALLY SPACED USE ALL 4 HOLES FOR MOUNTING UNIT. USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898/1 AND TORQUE TO SS74 OR SERVICE MANUAL VALUES.
EYEBOLTS (2) FOR LIFTING MARINE TRANSMISSION EYEBOLTS TO BE USED ON BOTH ENDS TO LIFT MARINE TRANSMISSION ONLY.
CENTER OF GRAVITY

Figure 3. MG-5222DC Marine Transmission Installation Specifications

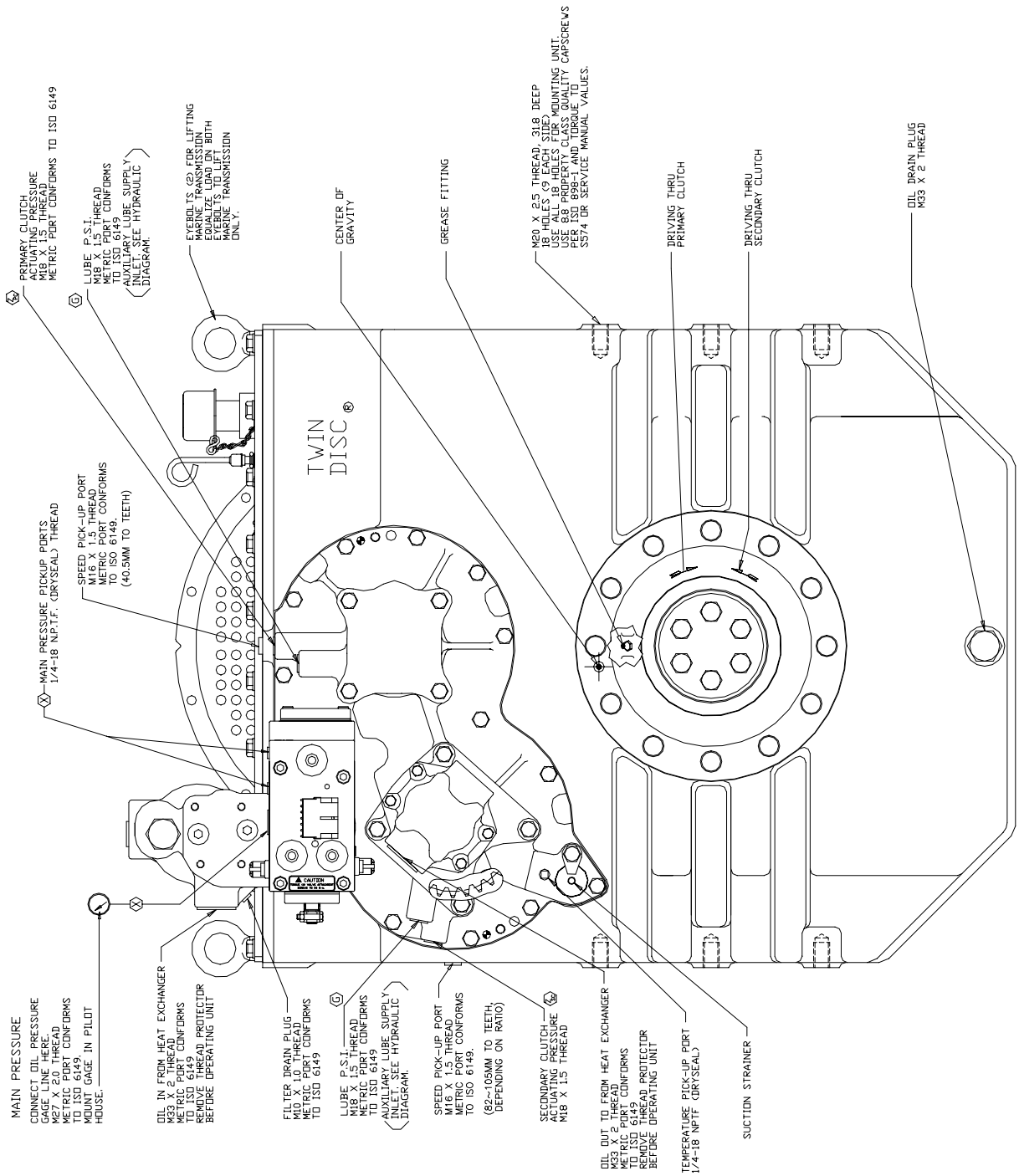

PRIMARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
LUBE P.S.I. M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149 AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
EYEBOLTS (2) FOR LIFTING MARINE TRANSMISSION EQUALIZE LOAD ON BOTH EYEBOLTS TO LIFT MARINE TRANSMISSION ONLY.
CENTER OF GRAVITY
GREASE FITTING
M20 X 2.5 THREAD, 31.8 DEEP 18 HOLES (9 EACH SIDE) 18 HOLES FOR MOUNTING UNIT. USE ALL PROPERTY CLASS QUALITY CAPSCREWS USE 8.8 PROPERTY CLASS OR BETTER AND TORQUE TO SS74 DR SERVICE MANUAL VALUES.
DRIVING THRU PRIMARY CLUTCH
DRIVING THRU SECONDARY CLUTCH
OIL DRAIN PLUG M33 X 2 THREAD
MAIN PRESSURE PICKUP PORTS 1/4-18 N.P.T.F. (DRYSEAL) THREAD
SPEED PICK-UP PORT M16 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149. (40.5MM TO TEETH)
TWIN DISC
MAIN PRESSURE CONNECT OIL PRESSURE GAGE LINE HERE. M27 X 2.0 THREAD METRIC PORT CONFORMS TO ISO 6149. MOUNT GAGE IN PILOT HOUSE.
OIL IN FROM HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE TAPE PROTECTOR BEFORE OPERATING UNIT
FILTER DRAIN PLUG M10 X 1.0 THREAD METRIC PORT CONFORMS TO ISO 6149
LUBE P.S.I. M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149 AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
SPEED PICK-UP PORT M16 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149. (82~105MM TO TEETH, DEPENDING ON RATIO)
SECONDARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD
OIL OUT TO FROM HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE TAPE PROTECTOR BEFORE OPERATING UNIT
TEMPERATURE PICK-UP PORT 1/4-18 NPTF (DRYSEAL)
SUCTION STRAINER

Figure 4. MG-5222DC Marine Transmission (with optional electric control valve) Installation Specifications

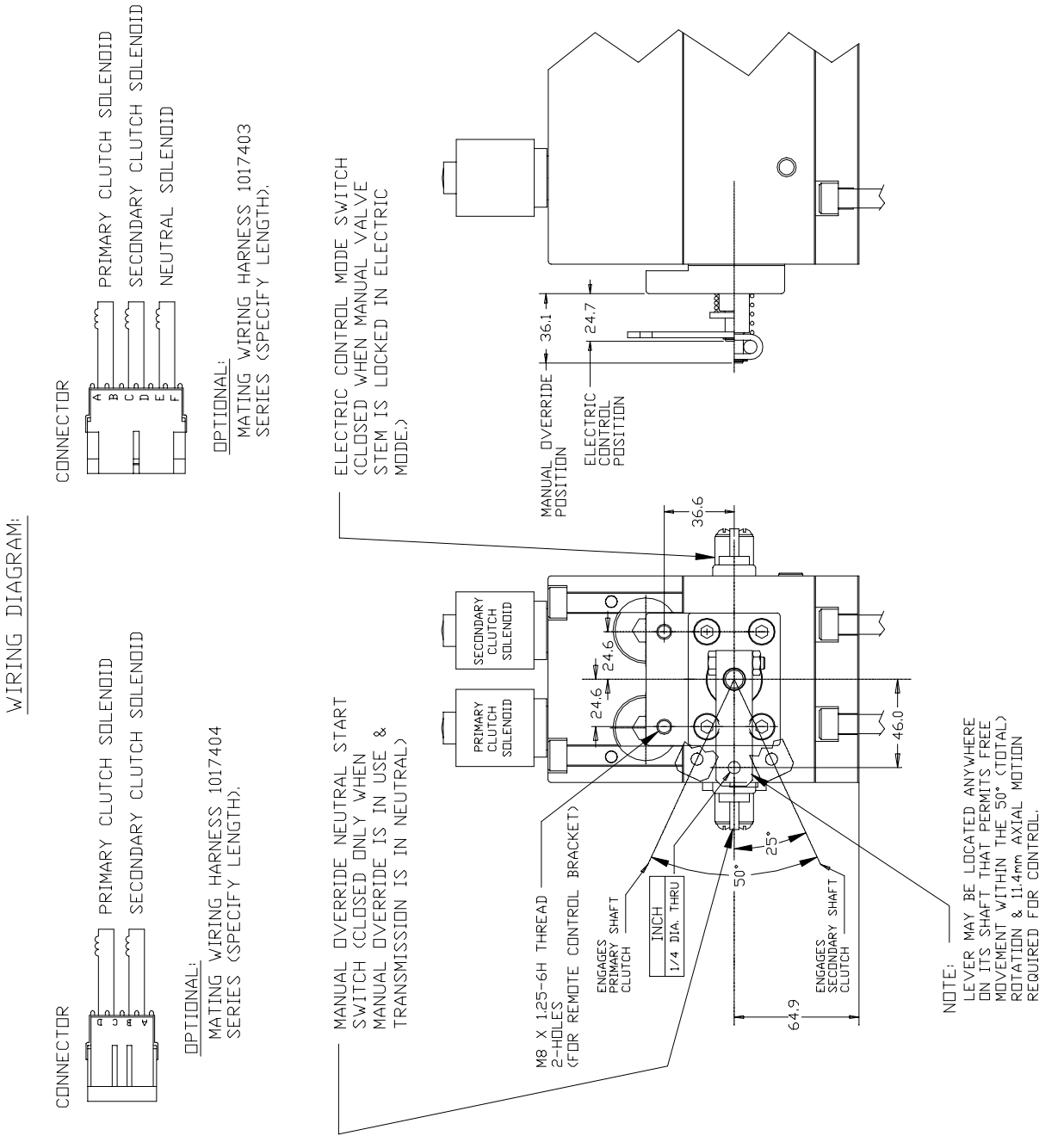


Figure 5. Optional Electric Control Valve Installation Specifications

Torque Values for Fasteners

Note: All threads and bearing face to be lubricated with light oil film prior to assembly.

Table 4. U.S. Standard Fine and Coarse Thread Capscrews, Bolts, and Nuts

Thread Diameter	SAE Grade 5		SAE Grade 8	
	lb-ft	Nm	lb-ft	Nm
1/4	6 - 8	8 - 11	10 - 12	14 - 16
5/16	13 - 17	18 - 23	20 - 24	27 - 32
3/8	25 - 29	34 - 39	35 - 41	48 - 55
7/16	37 - 43	51 - 58	55 - 65	75 - 88
1/2	60 - 70	81 - 95	83 - 97	113 - 131
9/16	82 - 98	111 - 132	120 - 140	163 - 190
5/8	120 - 140	163 - 190	165 - 195	224 - 264
3/4	205 - 245	278 - 332	295 - 345	400 - 467
7/8	330 - 390	448 - 528	470 - 550	638 - 745
1	495 - 585	671 - 793	715 - 835	970 - 1132
1 1/8	615 - 735	834 - 997	1015 - 1185	1377 - 1606
1 1/4	850 - 1000	1163 - 1355	1375 - 1625	1865 - 2203

Table 5. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm
M6	6.5 - 7.5	9 - 10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	987 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 6. Tapered Pipe Plugs (with thread lubricant)

NPTF Size (in)	In Steel or Cast Iron		In Aluminum	
	Nm (+ or - 5 %)	lb-ft (+ or - 5 %)	Nm (+ or - 5 %)	lf-ft (+ or - 5 %)
1/16-27	11.5	8.5	7.5	5.5
1/8-27	14	10.5	9	6.5
1/4-18	34	25	22	16
3/8-18	37	27	23	17
1/2-14	68	50	41	30
3/4-14	73	54	46	34
1 -11 1/2	108	80	68	50
1 1/4 - 11 1/2	115	85	75	55
1 1/2 - 11 1/2	115	85	75	55

Table 7. Straight Threaded Tube Fittings, Hose Fittings, and O-ring Plugs

Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %	Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %
5/16	5	3.5	M10X1.0	26	19
3/8	11.5	8.5	M12X1.5	37	27
7/16	16	12	M14X1.5	47	35
1/2	20	15	M16X1.5	58	43
9/16	24	18	M18X1.5	74	55
5/8	24	18	M22X1.5	105	77
11/16	34	25	M27X2.0 IN IRON	179	132
3/4	41	30	M27X2.0 IN ALUM	85	63
7/8	54	40	M33X2.0	326	240
1 1/16	75	55	M42X2.0	347	256
1 3/16	88	65	M48X2.0	441	325
1 1/4	88	65	-	-	-
1 5/16	108	80	-	-	-
1 3/8	108	80	-	-	-
1 5/8	135	100	-	-	-
1 7/8	162	120	-	-	-
2 1/2	312	230	-	-	-

Wear Limits

MG-5222DC Clutch Plates

Steel separator plates cone:

Minimum: 0.33mm (0.013 in.)

Maximum: 0.58mm (0.023 in.)

Friction clutch plates cone:

Maximum: 0.25mm (0.010 in.)

Friction plates minimum thickness: 2.90mm (0.114 inch).

Operation

General

The control valve obtains primary, neutral and secondary positions. When these positions are selected, the control valve directs high-pressure oil through internal passages to operate the clutches. The pressure-rate control piston within the control valve assembly provides a rapid, smooth, oil pressure increase in the hydraulic system during clutch engagement.

Hydraulic System with Manual Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil forces the pressure regulator piston against the springs to open the path to the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the heat exchanger to the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings. There is a lubrication oil pressure relief valve to limit maximum lubrication oil pressure to approximately 690 kPa (100 psi).

In Neutral, the inlet port of both clutches is connected to the atmosphere. Since the area behind the clutch pistons is open to sump, the clutches are disengaged. Oil is distributed through the lubrication system. The area between the pressure regulating piston and the rate-of-rise piston is connected to sump at all times to prevent any leakage oil from affecting the pressure regulation.

When the control valve is shifted to engage either clutch, the valve directs main pressure to engage the selected clutch pack. Oil is also directed to move the rate-of-rise piston, compressing the pressure regulator springs. This progressively increases the clutch engaging pressure causing the clutches to engage at a controlled rate.

The control valve allows only one clutch to be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

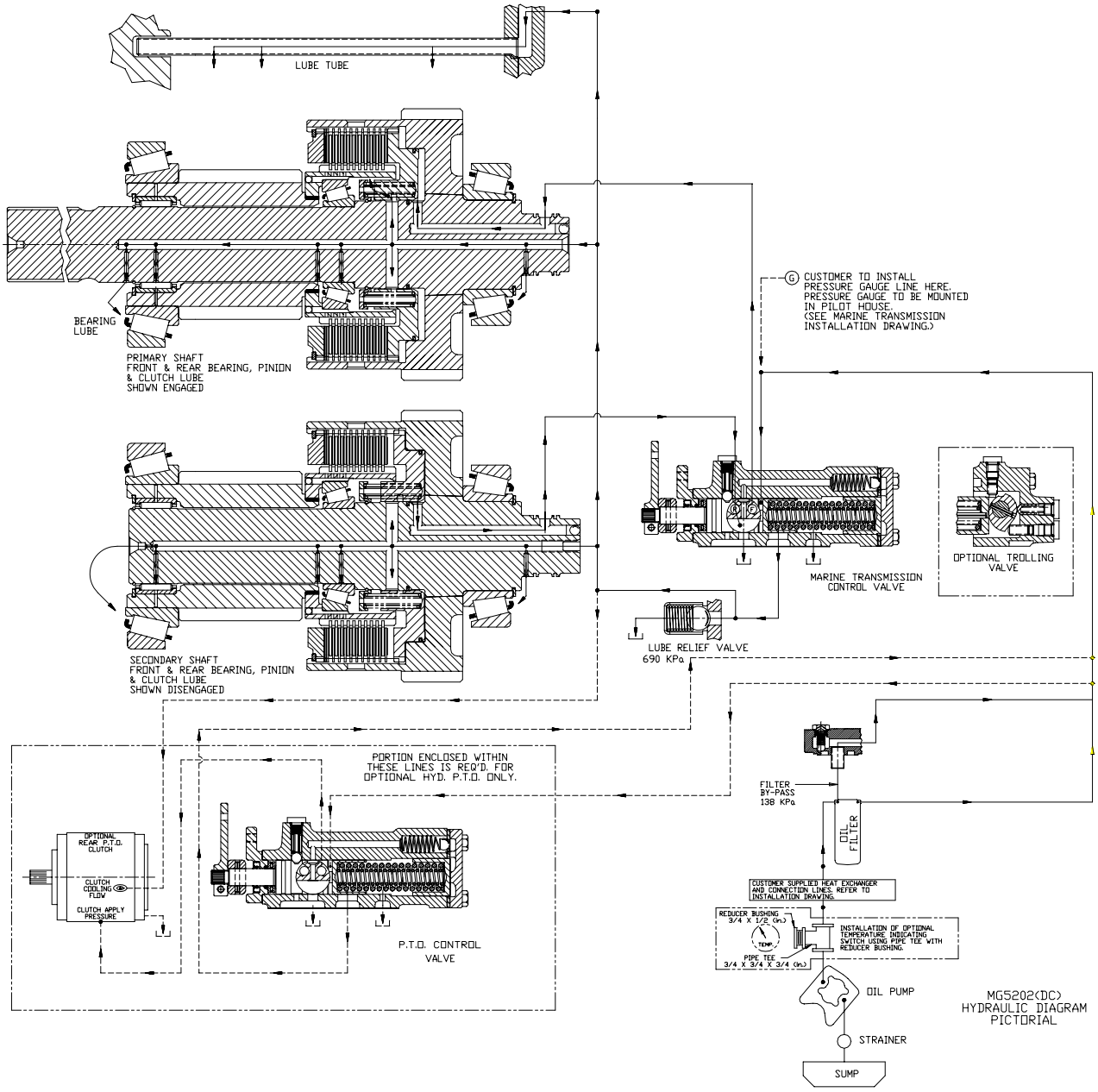

LUBE TUBE
BEARING LUBE
PRIMARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN ENGAGED
SECONDARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN DISENGAGED
G CUSTOMER TO INSTALL PRESSURE GAUGE LINE HERE. PRESSURE GAUGE TO BE MOUNTED IN PILOT HOUSE. (SEE MARINE TRANSMISSION INSTALLATION DRAWING.)
MARINE TRANSMISSION CONTROL VALVE
OPTIONAL TROLLING VALVE
LUBE RELIEF VALVE 690 KPa
PORTION ENCLOSED WITHIN THESE LINES IS REQ'D. FOR OPTIONAL HYD. P.T.O. ONLY.
OPTIONAL REAR P.T.O. CLUTCH
CLUTCH COOLING FLOW
CLUTCH APPLY PRESSURE
P.T.O. CONTROL VALVE
FILTER BY-PASS 138 KPa
OIL FILTER
CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES. REFER TO INSTALLATION DRAWING.
REDUCER BUSHING 3/4 X 1/2 (m.)
TEMP.
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHING.
PIPE TEE 3/4 X 3/4 X 3/4 (m.)
OIL PUMP
STRAINER
SUMP
MG5202(DC) HYDRAULIC DIAGRAM PICTORIAL

Figure 6. A7119R Hydraulic Schematic (manual control valve)

Manual Control Valve — Neutral

Refer to Figures 7 and 8. Oil enters the control valve body through passage A and fills chamber B. The oil causes the pressure regulating piston to partially compress the piston outer and inner springs against the pressure-rate control piston. This pressurizes the oil in chamber B. This pressure varies with engine speed.

The movement of the pressure regulation piston against the springs exposes port C in the valve body. Port C directs overage oil to the lubrication oil circuit. Passage D (which is the engaging outlet to the primary clutch) and Passage E (which is the engaging outlet to the secondary clutch) are interconnected by slot F in the control valve stem when in the neutral position. The slot is aligned with a drilled hole and cored cavity in the face of the valve body. The drilled hole and cored cavity are aligned and drilled holes that pass through the main housing to sump. Therefore, passages D and E are at atmospheric pressure at this time. Also, passage J is at atmospheric pressure because port H interconnects with slot F. This area between pistons and around springs is vented to the sump of the transmission. This area is at atmospheric pressure at all times permitting the return to sump of any leakage oil past the pistons.

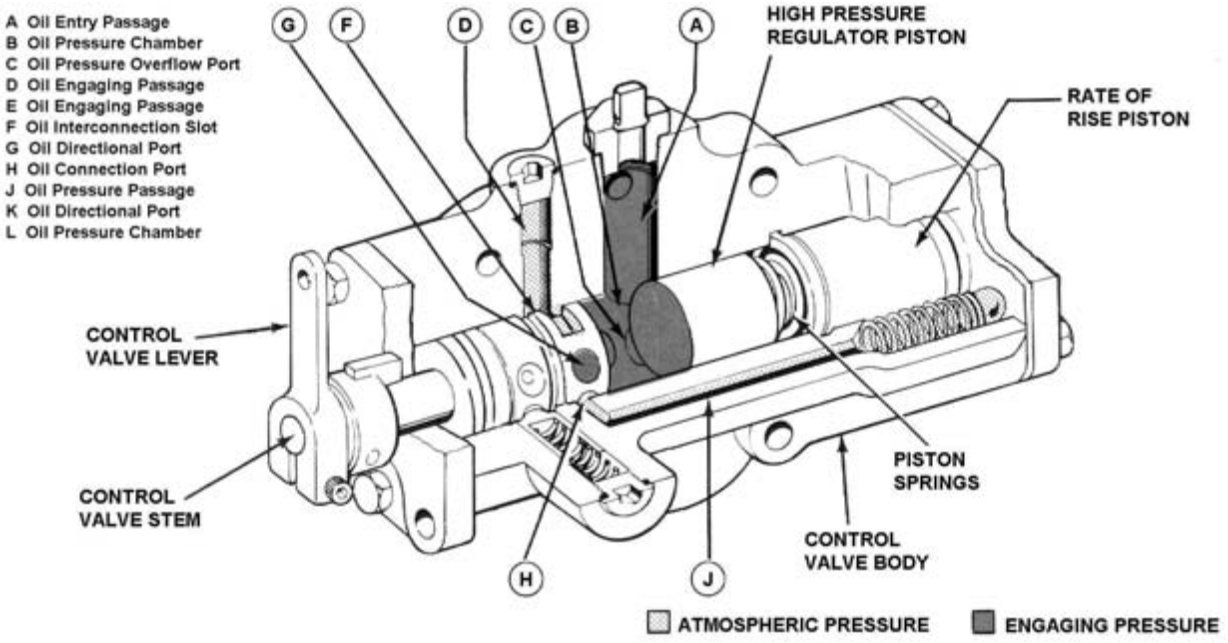


Figure 7. Manual Control Valve — Neutral — Sectional View

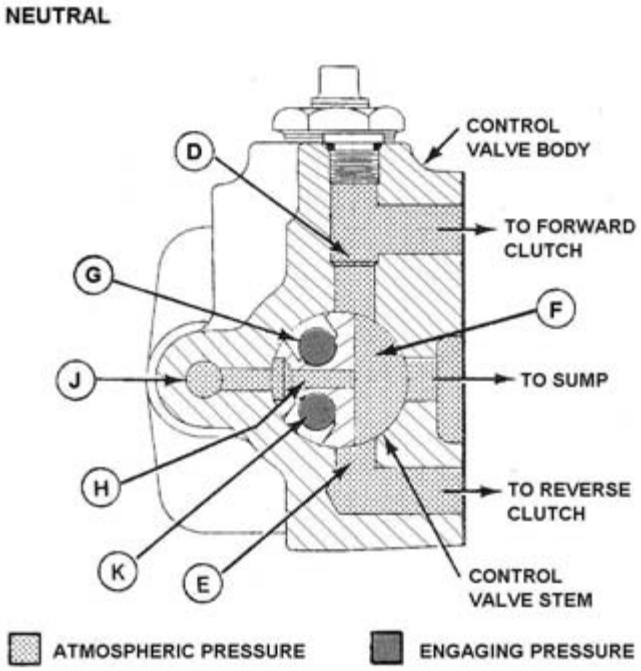


Figure 8. Manual Control Valve — Neutral — Cutaway View

Manual Control Valve — Primary

When a shift to the primary position is desired, the control valve lever is moved. The shift causes the control valve stem to rotate and assume the position indicated in Figures 9 and 10. The pressurized oil in chamber B is directed through ports G and K to passages D and J. Passage D is aligned with a passage directing main pressure oil to the primary clutch. Pressurized oil from port K travels through passage J and enters chamber L through an orifice in the orifice plate. The orifice in this plate meters the oil for a steady, smooth pressure rise in chamber L. As chamber L fills with oil, the pressure rate-control piston moves against the springs until the piston is stopped by a shoulder in the valve body. This causes the pressure in chamber B to rise to clutch engaging pressure. When in primary, passage E remains at atmospheric pressure because slot F remains open to sump.

When a shift is made from primary to neutral, the valve stem is rotated to the position illustrated by Figures 7 and 8. Under these conditions, passage D is connected to sump by slot F. Passage J also is connected to sump by port H in the valve stem. Because passage D is connected to slot F, oil drains rapidly from the primary clutch to sump. Because passage J is now at atmospheric pressure, the oil pressure in chamber L unseats the steel ball against the compression spring permitting a rapid oil drain from chamber L to sump and allowing the pressure-rate control piston to move back against the orifice plate. The primary clutch is now disengaged and main system pressure reduced to neutral pressure.

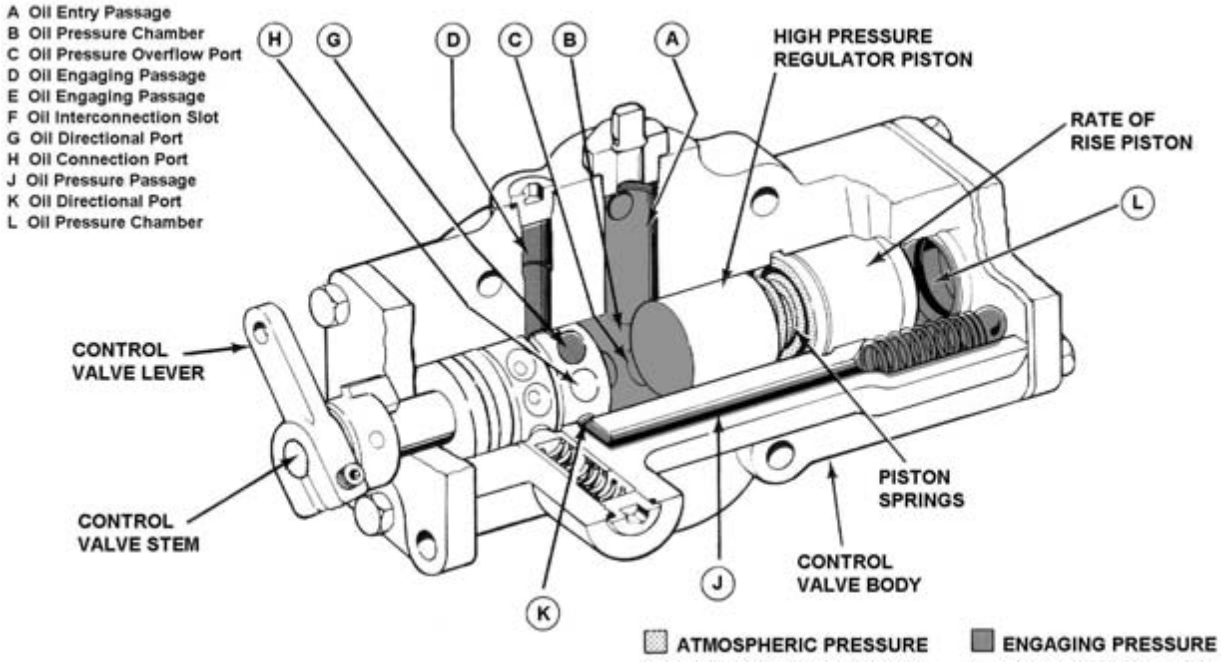


Figure 9. Control Valve — Primary — Sectional View

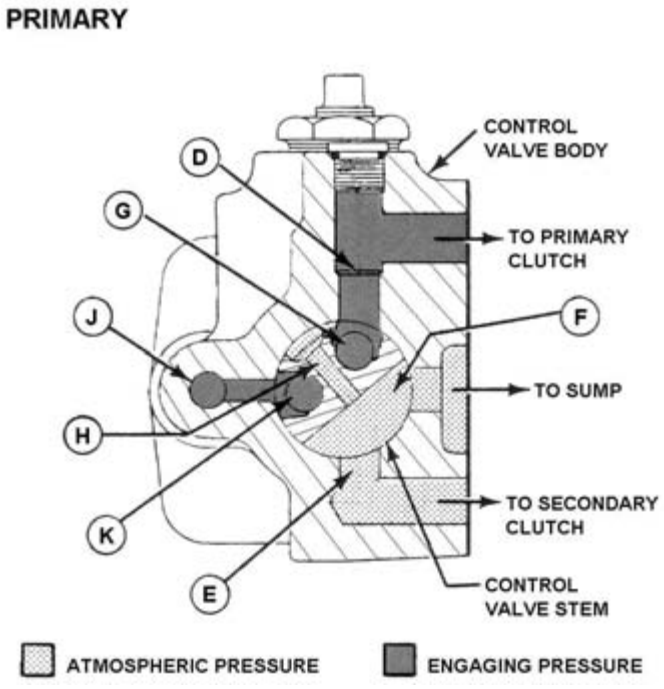


Figure 10. Control Valve — Primary — Cutaway View

Manual Control Valve — Secondary

When a shift to the secondary position is desired, the control valve lever is moved. The shift causes the control valve stem to rotate and assume the position indicated in Figures 11 and 12. The pressurized oil in chamber B is directed through ports G and K to passages E and J. Passage E is aligned with a passage directing main pressure to the secondary clutch. Pressurized oil from port G travels through passage J and enters chamber L through an orifice in the orifice plate.

The orifice in the plate meters the oil for a steady, smooth pressure rise in chamber L. As chamber L fills with oil, the pressure rate control piston moves against springs until the piston is stopped by a shoulder in the valve body. The causes the pressure in chamber B to rise to clutch engaging pressure.

When in secondary, passage D remains at atmospheric pressure because slot F remains open to sump. When a shift is made from secondary to neutral, the valve stem is rotated to the position illustrated by Figures 7 and 8. Under these conditions, passage E is connected to the sump by slot F. Passage J is also connected to sump by port H in the valve stem. Because passage E is connected to slot F, oil drains rapidly from the secondary clutch to sump. Because passage J is now at atmospheric pressure, the oil pressure in chamber L unseats the steel ball against the compression spring, permitting a rapid oil drain from chamber L to sump and allowing the pressure rate control piston to move back against the orifice plate. The secondary clutch is now disengaged and main system pressure reduced to neutral pressure.

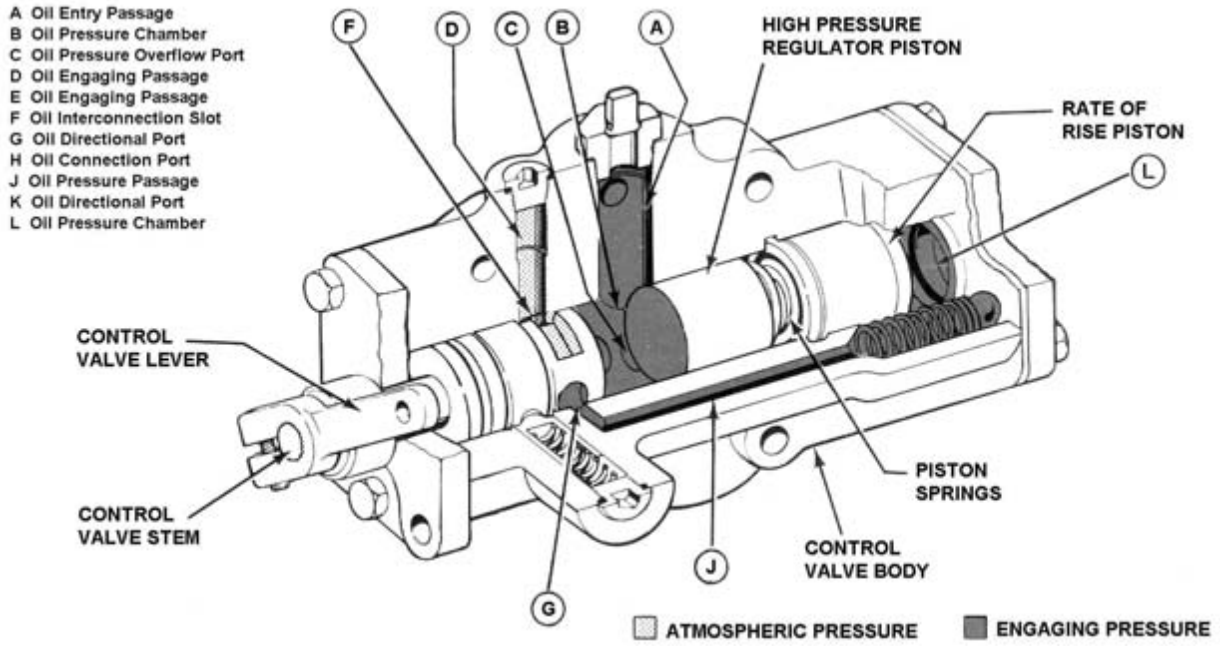


Figure 11. Control Valve — Secondary — Sectional View

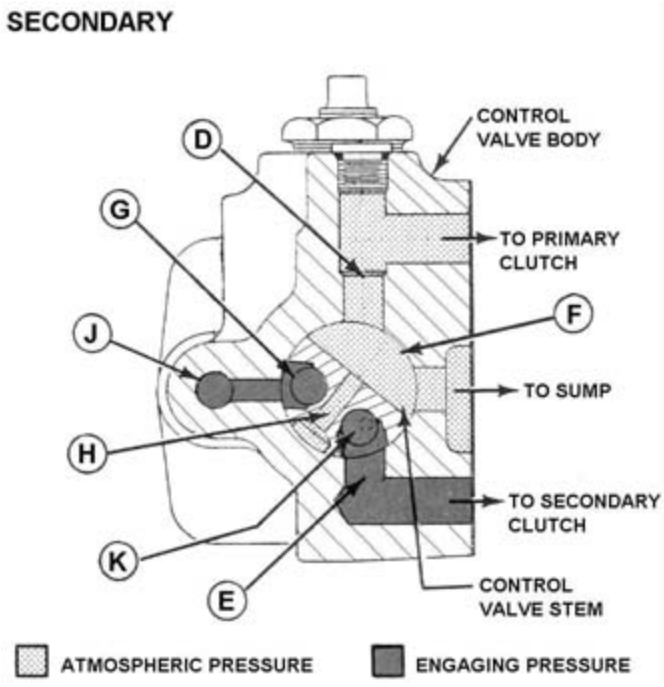


Figure 12. Control Valve — Secondary — Cutaway View

Hydraulic System with Electric Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil forces the pressure regulator piston against the springs to open the path to the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the heat exchanger to the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings. There is a lubrication oil pressure relief valve to limit maximum lubrication oil pressure to approximately 690 kPa (100 psi).

In Neutral, the inlet port of both clutches is connected to the atmosphere. Since the area behind the clutch pistons is open to sump, the clutches are disengaged. Oil is distributed through the lubrication system. The area between the pressure regulating piston and the rate-of-rise piston is connected to sump at all times to prevent any leakage oil from affecting the pressure regulation.

The pressure in the rate-of-rise chamber is controlled by a ball that is spring loaded against the orifice plate. The passage behind the ball and spring is connected to the sump (atmosphere) in Neutral and to main pressure when either clutch is engaged. A shuttle ball, connected to both clutch pressure ports, permits pressurizing this passage with oil from the engaged clutch without allowing oil to flow to the disengaged clutch.

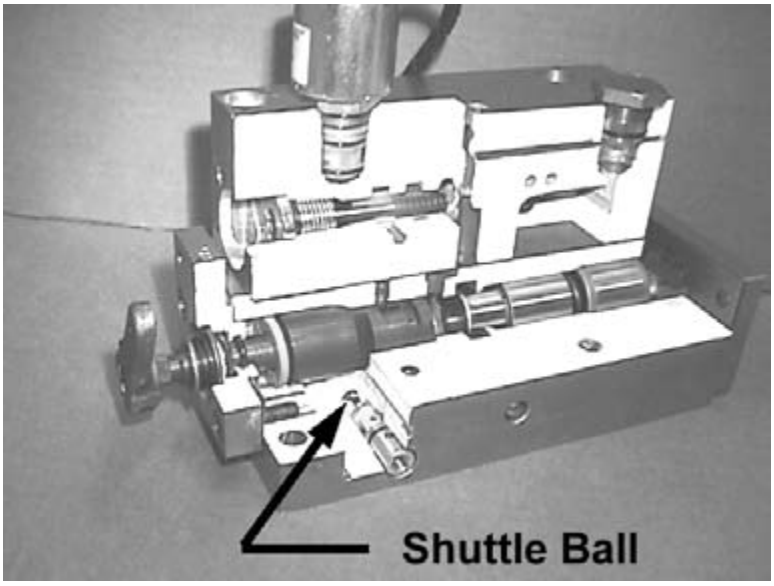


Figure 13. Location of Shuttle Ball

The electric control valve can be used in a manual override mode in the event of an electrical power failure.

When the control valve is energized or shifted to engage either clutch, the valve directs main pressure to engage the selected clutch pack. Oil is also directed to move the rate-of-rise piston, compressing the pressure regulator springs. This progressively increases the clutch engaging pressure causing the clutches to engage at a controlled rate.

The control valve allows only one clutch to be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Control Valve Assembly in Neutral

Some of the main pressure oil from the oil inlet chamber flows through a passage to the orifice in the orifice plate. The small flow of oil through this orifice fills and begins to pressurize the rate-of-rise chamber.

Both clutches are connected to sump when the control valve is in Neutral. Since there is no pressure acting on the shuttle ball from either clutch, the passage behind the ball and spring regulator is also connected to sump. This allows the oil pressure in the rate-of-rise chamber to be regulated by the ball and spring, since the overage oil can flow to sump. The oil pressure in the rate-of-rise chamber acting on the rate-of-rise piston causes it to stroke over partially, which compresses the pressure regulating springs additionally. This additional spring compression further resists the movement of the pressure regulating piston, resulting in a force balance between the area at the pressure regulator, the springs, and the area behind the rate-of-rise piston. Neutral main pressure of approximately 40 psi is maintained by relieving excess oil behind the rate-of rise piston through the ball and spring regulator.

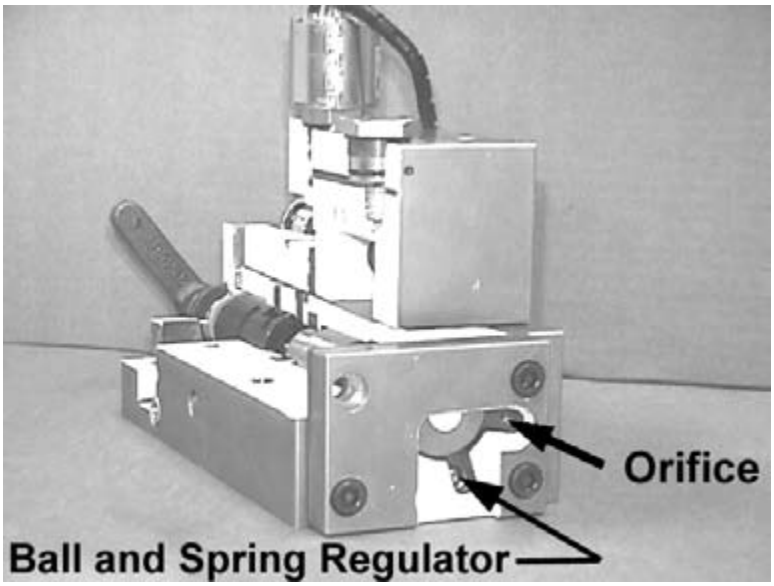


Figure 14. Neutral Regulator and Rate of Rise Orifice

Control Valve Assembly in Primary or Secondary

Pressurized oil is directed to one of the transmission's clutches to engage it. The pressurized oil in the clutch port of the engaged clutch acts on the shuttle ball, sealing off the passage to the opposite clutch. The pressurized oil also forces the ball of the ball and spring regulator against its seat on the orifice plate, stopping the flow of oil from the rate-of-rise chamber to sump. Since oil continues to flow into the rate-of-rise chamber through the orifice, the oil pressure in the rate-of-rise chamber increases. This increased oil pressure forces the rate-of-rise piston to stroke over to its stop in the valve body, compressing the pressure regulating springs even further yet.

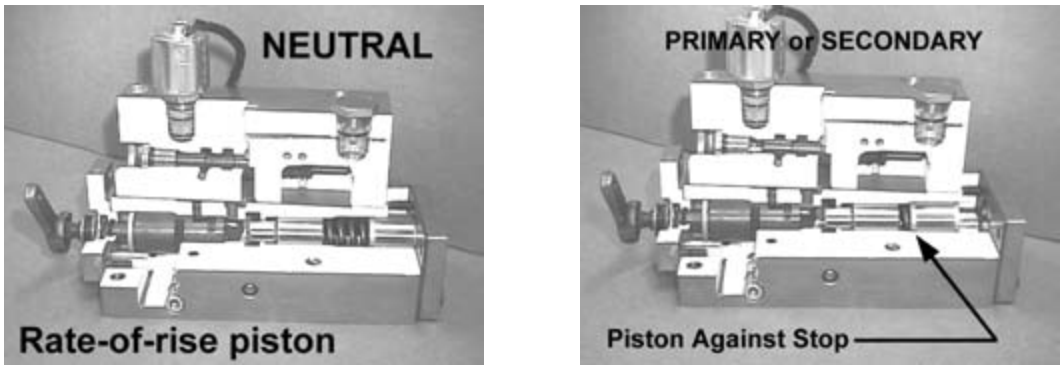


Figure 15. Rate of Rise Piston in Neutral (left) and Rate of Rise Piston with Clutch Engaged (right)

The travel rate of the rate-of-rise piston (and resulting pressure rate-of-rise) is controlled by the orifice size, regulator spring stiffness and the final main pressure after completion of the rate-of-rise cycle. Neutral main pressure controls the start time of the rate-of-rise cycle. When the rate-of-rise piston is against the stop (pressure regulating springs are compressed the most), the main oil pressure reaches approximately 250 psi.

When the control valve is shifted to Neutral, the clutch that was engaged is vented to sump within the valve. As a result, the passage behind the ball and spring regulator is vented to sump and induces a high differential pressure between the rate-of-rise chamber and the passage behind the ball and spring. Since the pressure in the rate-of-rise chamber is much greater than the pressure it is to be regulated at, the ball unseats from the orifice plate, allowing main oil pressure to return to the neutral pressure level rapidly and again be regulated by the ball and spring regulator. The ball returns to the pressure regulating position once the spring force is equal to force induced by the pressure at the rate-of-rise piston.

Electric Operation

The transmission normally operates with the control valve in the electric mode. Two spools, each controlled by a solenoid operated pilot valve, control clutch engagement. When a solenoid is energized, it opens the pilot valve and allows main pressure oil to flow to the end of the spool. The pressure acting on the end of the spool overcomes the return spring at the opposite end, causing the spool to stroke over and connect the clutch passage with main pressure passage.

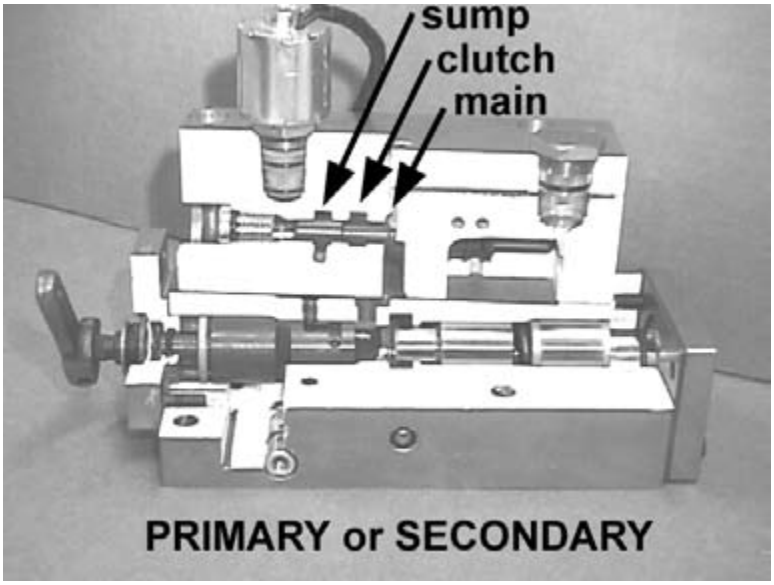


Figure 16. Pilot Spool Passages

Main pressure oil flows from the spools above to the clutch passages of the transmission below via connecting slots in the manual override stem. These connecting slots are aligned with passages in the valve body when the valve is in the electric mode.

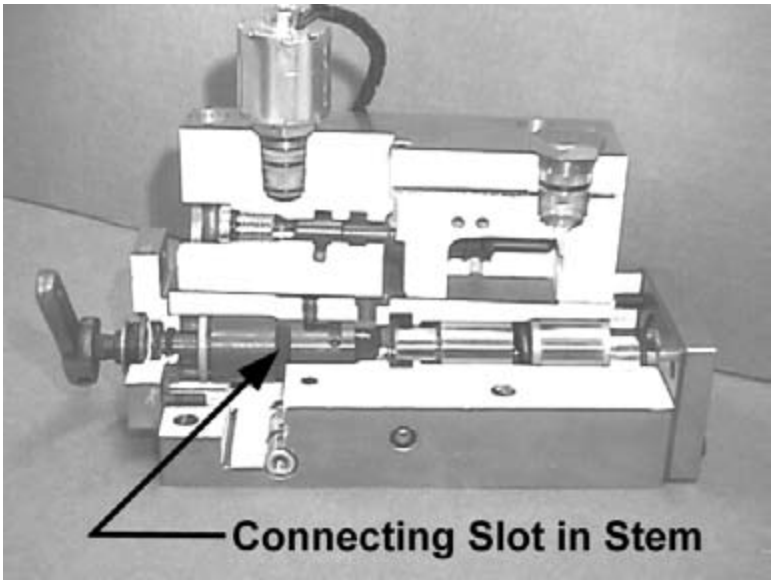


Figure 17. Flow Path in Override Spool

Main pressure from the energized solenoid operated pilot valve also acts on a pin on the return spring side of the opposite spool to ensure the opposite spool is connecting its clutch to sump. The clutch engagement cycle is outlined in the previous section.

Hydraulic Lock Feature (some models)

Some control valve models have a hydraulic lock feature, and are identifiable by a third solenoid operated pilot valve. This feature keeps the engaged clutch pressurized as long as the engine remains running, should electrical power fail or malfunction occur while the clutch is engaged. The hydraulic lock is accomplished by allowing pressurized oil (from the pressurized clutch passage) to flow inside the spool. Oil pressure inside the spool forces the dowel pin against the O-ring plug.

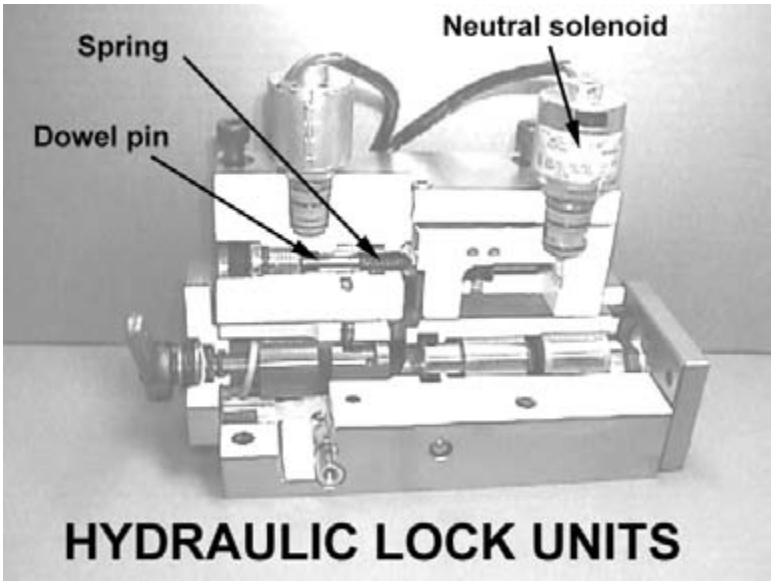


Figure 18. Hydraulic Lock Units

The resulting reaction is a force on the spool that overcomes the spool's return spring force. Should the solenoid become de-energized while the spool has its clutch pressurized, oil pressure will keep the spool in that position. This keeps the transmission in gear as long as the engine is running.

The hydraulic lock is disabled when either the engine is stopped, or the neutral solenoid is energized. When the neutral solenoid is energized, it sends pressurized oil to the dowel pins at the return spring end of each spool.
Since the dowel pin used at the return spring side of the spool is larger in diameter than the dowel pin inside the spool, the hydraulic force acting on the larger pin forces the spool to connect the clutch passage to sump with assistance from the return spring.

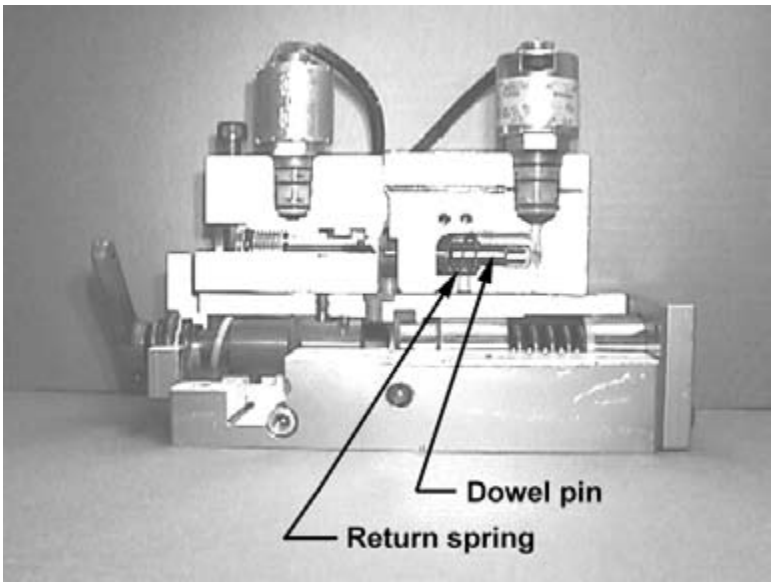


Figure 19. Neutral Solenoid Engaged

Manual Override Operation

The control valve has a manual override feature, which is a lever operated selector. When the manual override lever is rotated counterclockwise and pulled outwards, the upper portion of the valve is disabled because the connecting slots in the manual override stem are no longer aligned with the oil passages in the valve body. Oil pressure from the solenoid operated pilot valve controlled spools cannot reach the clutch pressure passages in the transmission. The main oil pressure regulator, shuttle ball, neutral pressure regulator, and rate-of-rise functions remain exactly the same as when the valve is in the electric mode. In the manual override position, shifting is controlled by rotating the lever on the manual override stem.

In the Neutral position, both clutches are vented to sump by two pockets in the stem.

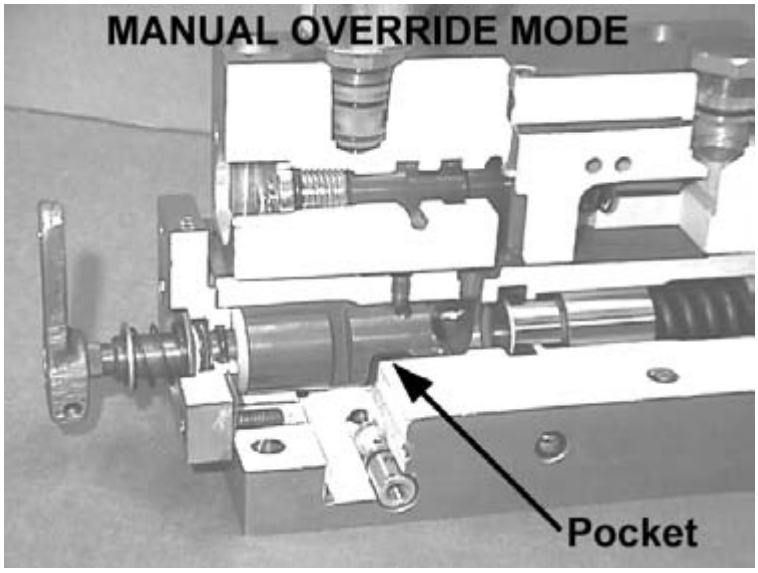


Figure 20. Stem Pocket or Passage

Main pressure oil can flow through the hole in the end of the stem to a narrow slot between the two pockets. This slot does not connect to any other passages when the stem is in the Neutral position.

When the lever and stem are rotated to engage either the primary or secondary clutch, main pressure oil flows through the slot in the stem to the appropriate clutch pressure port. The opposite clutch port passage remains connected to sump by the same pocket in the stem as when the stem was in the Neutral position. When the stem is rotated back to the Neutral position, the main pressure oil slot in the stem is no longer aligned with either clutch port. Both clutches are again vented to sump by the two pockets in the stem.

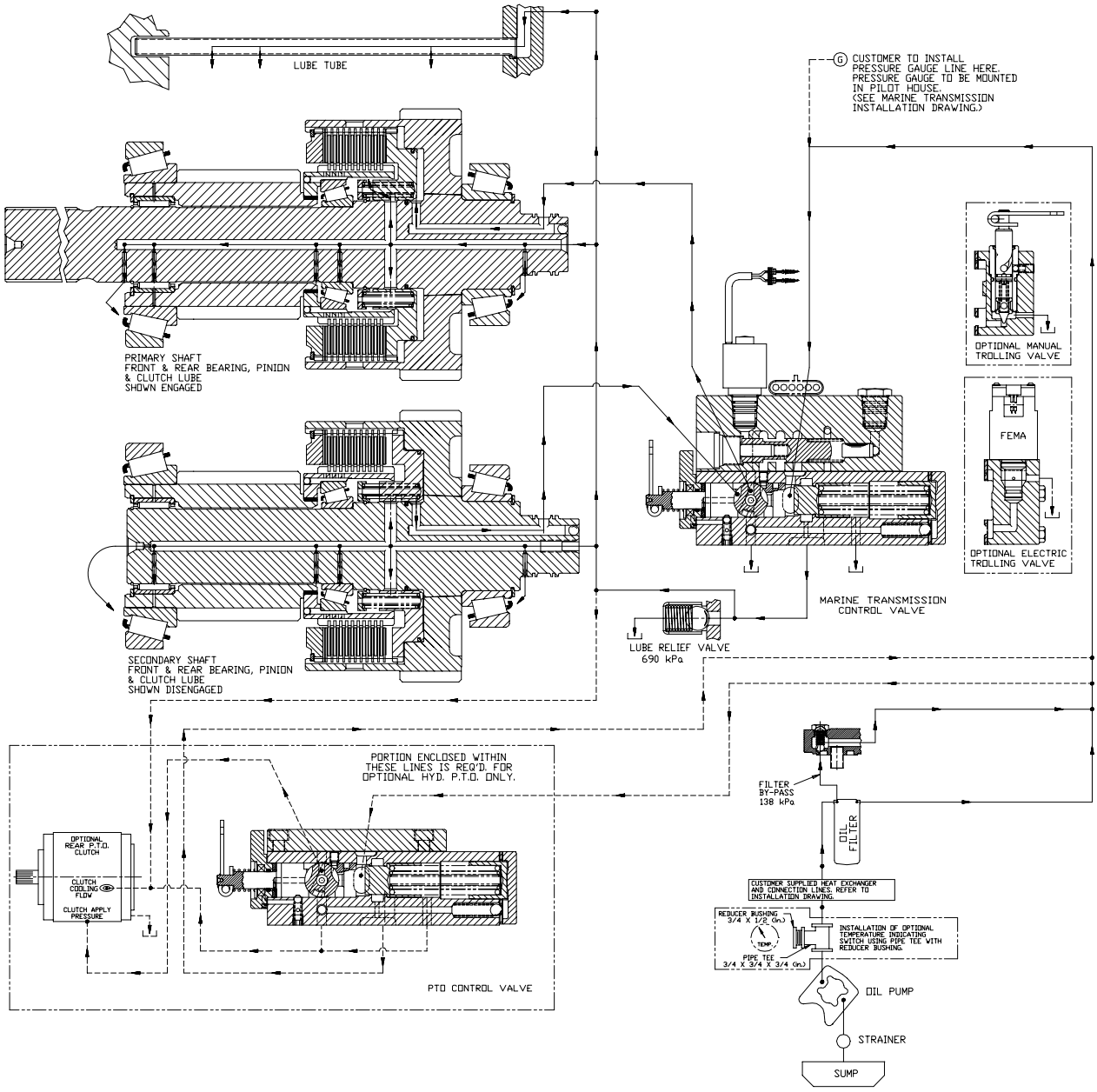

LUBE TUBE
G CUSTOMER TO INSTALL PRESSURE GAUGE LINE HERE. PRESSURE GAUGE TO BE MOUNTED IN PILOT HOUSE. (SEE MARINE TRANSMISSION INSTALLATION DRAWING.)
PRIMARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN ENGAGED
OPTIONAL MANUAL TROLLING VALVE
FEMA
OPTIONAL ELECTRIC TROLLING VALVE
MARINE TRANSMISSION CONTROL VALVE
LUBE RELIEF VALVE 690 kPa
SECONDARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN DISENGAGED
PORTION ENCLOSED WITHIN THESE LINES IS REQ'D. FOR OPTIONAL HYD. P.T.O. ONLY.
OPTIONAL REAR P.T.O. CLUTCH
CLUTCH COOLING FLOW
CLUTCH APPLY PRESSURE
PTO CONTROL VALVE
FILTER BY-PASS 138 kPa
OIL FILTER
CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES. REFER TO INSTALLATION DRAWING.
REDUCER BUSHING 3/4 X 1/2 (m.)
TEMP.
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHING.
PIPE TEE 3/4 X 3/4 X 3/4 (m.)
OIL PUMP
STRAINER
SUMP

Figure 21. Hydraulic Schematic (electric control valve)

Trolling Valve (Optional)

The trolling valve is used to reduce and control propeller speed below that normally attained by operating the engine at low idle. Actuating the trolling function reduces clutch apply pressure to reduce the propeller speed.

Mechanical Trolling Valve

This trolling valve is a variable orifice that controls the pressure in the rate-of-rise chamber. The pressure in the rate-of-rise chamber determines the rate-of-rise piston position, which ultimately controls the main and clutch pressures for the transmission.

When the trolling valve lever is in the detent (non-trolling) position, the orifice in the trolling valve is closed. Oil cannot exit from the rate-of-rise chamber through the trolling valve's orifice, and the rate-of-rise chamber is fully pressurized (the ball and spring regulator is blocked when either clutch is engaged). This full pressure causes the rate-of-rise piston to remain against its stop in the valve body bore, and main oil pressure is not reduced.

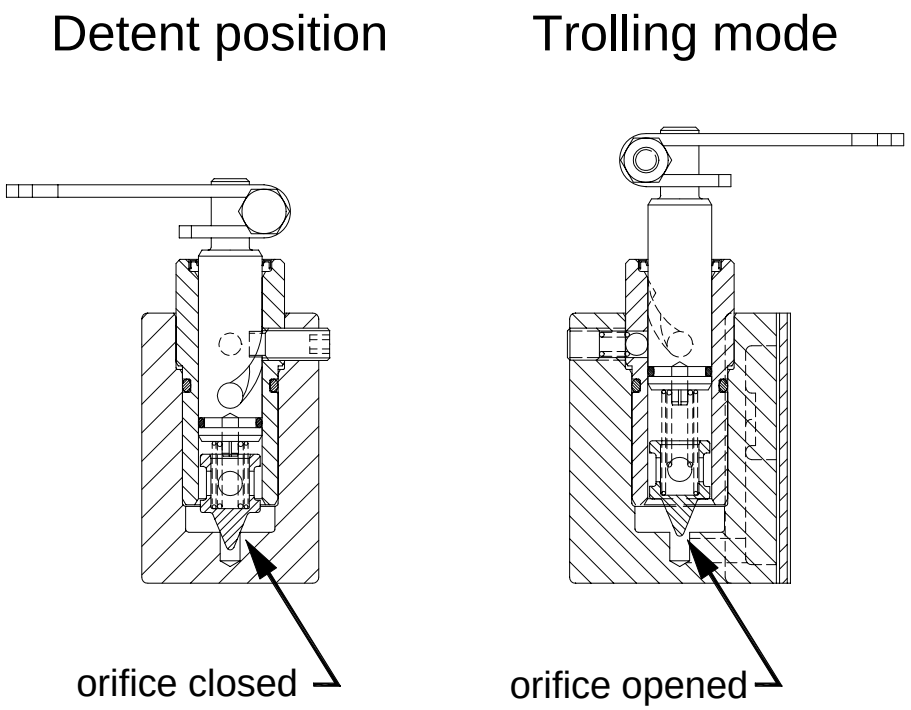


Figure 22. Mechanical Trolling Valve

Rotating the trolling valve lever into the trolling mode opens the variable orifice, allowing some of the oil to escape from the rate-of-rise chamber to sump. This reduces the oil pressure in the rate-of-rise chamber. Since oil is always flowing into the rate-of-rise chamber through the orifice in the orifice plate, the pressure in the rate-of-rise chamber is controlled by how much oil is allowed to exit through the trolling valve's variable orifice. The trolling valve lever position determines the pressure in the rate-of-rise chamber, which determines main oil pressure. Main oil pressure is always the same as the oil pressure in the engaged clutch with this type of trolling valve.

1017554 Electric Trolling Valve

This trolling valve is a variable orifice that controls the pressure in the rate-of-rise chamber. The pressure in the rate-of-rise chamber determines the rate-of-rise piston position, which ultimately controls the main and clutch pressures for the transmission. The only difference between the electric trolling valve and the previously described mechanical trolling valve is that the electric trolling valve's orifice size is controlled by electrical current instead of a lever.

When the trolling valve is in the cruise (non-trolling) mode, the orifice in the trolling valve is closed. Oil cannot exit from the rate-of-rise chamber through the trolling valve's orifice, and the rate-of-rise chamber is fully pressurized (the ball and spring regulator is blocked when either clutch is engaged). This full pressure causes the rate-of-rise piston to remain against its stop in the valve body bore, and main oil pressure is not reduced.

The trolling valve is actuated by sending a controlled amount of current through the valve's coil. As the current is increased, the orifice progressively opens, allowing oil pressure from the rate-of-rise chamber to escape to sump. Since oil is always flowing into the rate-of-rise chamber through the orifice in the orifice plate, the pressure in the rate-of-rise chamber is controlled by how much oil is allowed to exit through the trolling valve's variable orifice. Since the oil pressure in the rate-of-rise chamber is reduced, clutch pressure is reduced which allows the clutch plates to slip. The amount of clutch slip is controlled by the current flow (amps) through the valve's coil. Decreasing the current through the valve's coil will increase clutch pressure and therefore reduce clutch slip. Main oil pressure is always the same as the oil pressure in the engaged clutch with this type of trolling valve. The 1017170 valve contains no user serviceable parts, and is available only as an assembly.

Power Take-off (Optional)

There is a separate manual (part number 1020075) which describes the operation, installation, troubleshooting, and service of the optional Power Take-off (PTO) for this marine transmission.

Live Power Take-off

The live PTO drives accessories using engine horsepower. Since the live PTO connects the accessory to the primary shaft of the transmission via a direct coupling, the accessory is driven when the engine is running.

Hydraulic Clutched Power Take-off

The hydraulic clutched PTO also allows accessories to be driven using engine horsepower. Since the PTO is attached to the primary shaft of the transmission, the accessories can be driven any time the engine is running. The PTO is engaged by the PTO control valve, which is very similar to the valve used to control the transmission clutches.

The hydraulic clutched PTO operates with an engaged clutch pressure greater than that of the transmission's primary and secondary clutches. For this reason, the PTO control valve (pressure increasing valve) is in the transmission's hydraulic circuit before the control valve's inlet and pressure regulator. Pressurized oil from the filter is directed to the PTO control valve, with the overage oil flowing to the transmission's control valve.

Trailing Pump (Optional)

The trailing pump is used to supply oil flow to the transmission lubrication circuit when the transmission is in a backdriving condition. Backdriving (sometimes referred to “windmilling”) occurs when the engine is shut down and the transmission output shaft is being driven by water flow across the propeller.

The remote trailing pump option is driven by an electric motor. This trailing pump pulls oil through its suction strainer and discharges it through a filter to a check valve. The oil then flows through an oil-to-air heat exchanger and into the transmission’s lubrication circuit via one of the lubrication oil pressure test ports.

Power Flow

Input power to the transmission is through a torsional coupling mounted on the engine flywheel. The coupling is splined to the forward end of the primary (forward clutch) shaft causing the primary shaft to rotate in engine direction during engine operation. Power is transmitted to the secondary shaft by means of the transfer gear teeth on the outer diameter of the primary clutch housing. These teeth are in constant mesh with gear teeth on the of the secondary clutch housing causing the secondary shaft to rotate in anti-engine direction. The primary and secondary pinions on their respective shafts are in constant mesh with the output gear, which is connected to the output shaft through a keyless tapered joint.

Application of the primary clutch locks the primary pinion to the primary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in anti-engine direction. Application of the secondary clutch locks the secondary pinion to the secondary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in engine direction.

Neutral

When in neutral the primary and secondary shafts, transfer gears and clutch friction plates rotate at engine speed.

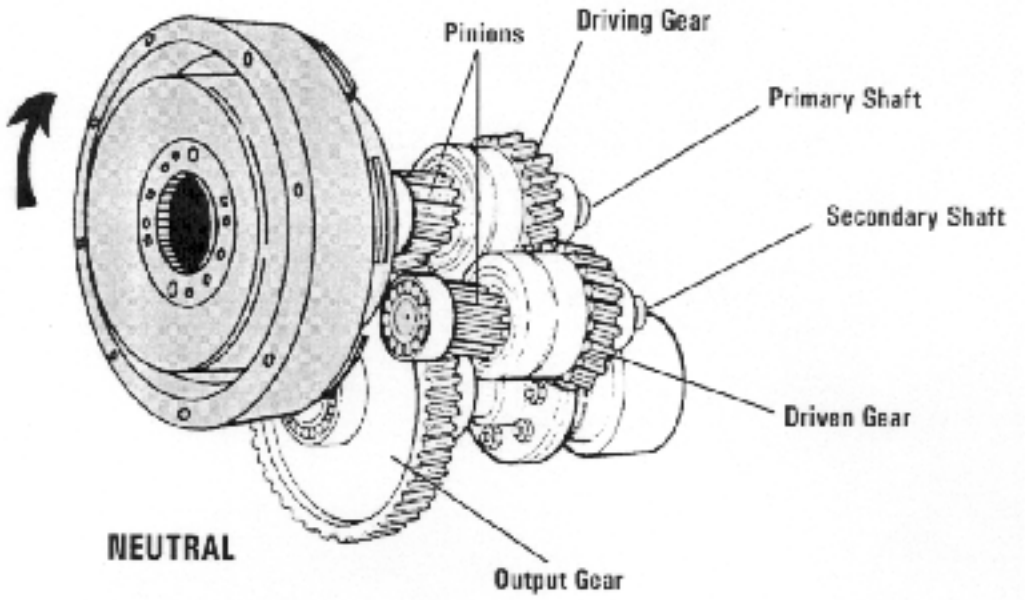


Figure 23. MG-5222DC Power Flow in Neutral

Primary

When the primary position is selected, hydraulic pressure is applied to the primary clutch piston clamping the friction and steel clutch plates together. The primary input pinion will then rotate at engine speed and direction because the steel plates are spline-connected through the clutch hub assembly to the pinion. Because the primary input pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The secondary input pinion will be backdriven (engine direction) when the unit is in the primary position.

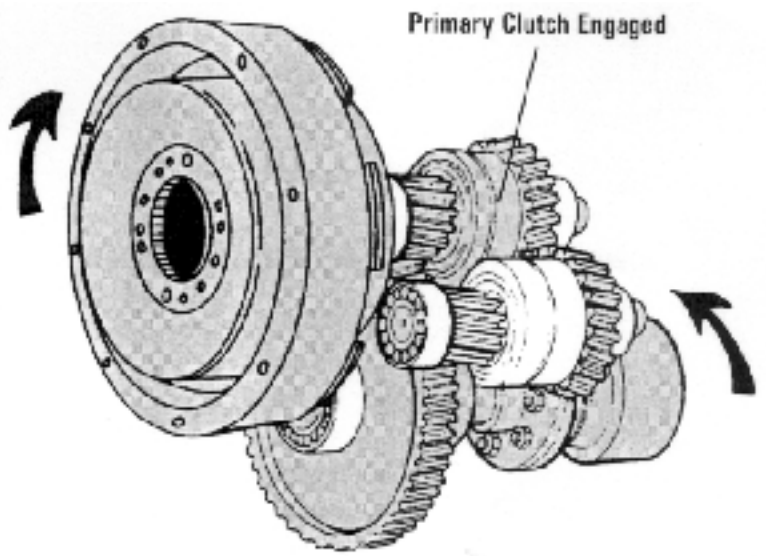


Figure 24. MG-5222DC Power Flow with Primary Clutch Engaged

Secondary

In secondary, the same parts are turning that were turning in neutral. When the secondary position is selected, hydraulic pressure is applied to the secondary clutch piston clamping the friction and steel plates together. The secondary input pinion will then rotate at engine speed and anti-engine direction, because the steel clutch plates are spline connected through the clutch hub assembly to the input pinion. Because the secondary input pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The primary input pinion will be backdriven (anti-engine direction) when the unit is in the secondary position.

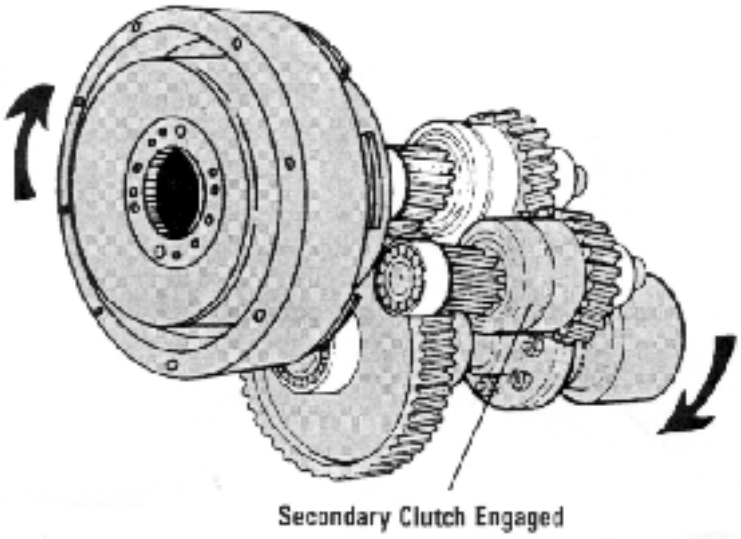


Figure 25. MG-5222DC Power Flow with Secondary Clutch Engaged

Preventative Maintenance

In-boat Maintenance and Repair

Certain transmission maintenance/repair procedures can be accomplished in the boat provided sufficient space exists to work. These procedures are:

- ❑ Removing and installing the oil pump.
- ❑ Changing the filter.
- ❑ Removing, cleaning and installing the suction strainer.
- ❑ Removing and installing the control valve.
- ❑ Removing and installing the manifold or top cover, bearing carrier and lube tube.
- ❑ Removing and installing the primary and secondary shaft assemblies.

Note: See special tools section for lifting bracket to aid in shaft removal or installation.

- ❑ Changing primary and secondary clutch plates.

Note: Further disassembly/reassembly of the primary or secondary shafts will require use of tools and equipment normally not available on board the vessel.

General Maintenance

Lubrication

Grease the oil seals on the output end of the output shaft through the grease fitting with water pump (lithium soap-based NLGI No. 2) grease. Apply grease every 100 hours or when the boat is docked.

No other lubrication is required beyond the daily oil check.

Oil System

Oil Level

The oil level should be checked daily or every 10 hours. Check oil level before starting the engine to confirm that the transmission has oil in it. With the engine running at low idle and the transmission in Neutral, check the oil again. The oil level should be near the “low” oil level mark. Transmission oil temperature should be in the normal operating range prior to finalizing the oil level between the low and full marks on the oil level gauge.

Oil and Filter Change Interval

With a new transmission, change the oil and filter element within the first 50 hours of operation. Change oil and filter element after each 1000 hours thereafter or more often if conditions warrant.

For a rebuilt transmission, check the filter element after eight hours of operation. If the filter is clean, install a new filter element and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service or more often if conditions warrant.

Draining

Drain the transmission by removing the O-ring plug at the rear side at the bottom.

Oil Suction Strainer

Remove and clean the pump suction strainer at every oil change or sooner if necessary. The suction strainer is located in the manifold below the pump. See Engineering Drawings for suction strainer location.

Type Oil Recommended

See Description and Specifications.

Filling

1. Remove the filler breather in the top cover of the transmission.

2. Fill the transmission's sump with 31.4 liters (8.3 U.S. gal.) of the proper weight and type oil. See Description and Specifications for oil recommendations.

3. Start the engine and let it idle with transmission in neutral until oil is circulated throughout the hydraulic system. Add oil if necessary to bring the oil level up to the "low" mark with the engine at low idle.

4. With the oil at operating temperature, transmission in neutral, and the engine running at low idle, check the oil level with the oil gauge. Add or remove oil if necessary to bring the oil level to "FULL" mark on the oil gauge.

5. Allow the oil temperature to cool to normal cold oil conditions (perhaps overnight). Check the oil level while cold at low idle engine speed while in neutral. Make note of the oil level in the cold conditions for future reference, as it corresponds to the correct oil level at operating temperature.

Torsional Coupling

Do not obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. The ambient temperature of the air around the coupling should be between -6˚C (22˚F) and 80˚C (176˚F). Assure baffles are installed properly so hot air is ported out of the housing.

Visually inspect the element after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. The above-described items affect the life of the coupling element.

When inspecting the flexible coupling, look for evidence or conditions identified in the following steps:

- ❑ Cracks in the surface of the rubber. May be caused by torsional vibrations, excessive misalignment or exposure to contaminants (heat, petroleum products, chemicals, ozone, ultraviolet radiation, etc.) excessive system torques.
- ❑ Separation of rubber from flex plate on coupling plate or deterioration of the rubber-to-metal bond. See above.
- ❑ Deterioration of the rubber element, as evidenced by sponginess or by black carbon-like dust on rubber surface. May be caused by contaminants or excessive heat, either external or internal to the coupling.
- ❑ Cracked, bent or otherwise damaged flex plate or coupling plate.
- ❑ Bolt holes in flex plate or coupling plate elongated oval shaped, not round. This could be caused by improperly assembled parts, loose parts, vibration or improperly torqued parts.
- ❑ Bolts/nuts—bent, worn or stripped threads.

Inspect the hub, looking for the following:

- ❑ Damaged or worn splines.
- ❑ Cracked parts.
- ❑ Oil seal surface for wear or damage.

Replace any defective parts including defective fasteners that are found.

Heat Exchanger Check

Heat exchangers furnished by Twin Disc to be used for salt water applications have zinc rods installed at the inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection.

Excessive corrosion of the zinc rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or external grounded electric current. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign materials, they should be cleaned with a wire brush.

Overhaul Interval

A complete overhaul of the unit should be made at the same time that the engine is overhauled.

Periodic Visual Inspection

- ❑ Check the mountings for tightness or damage such as cracks. Tighten loose mountings and replace damaged parts.
- ❑ Check pressure and temperature gauge where applicable.
- ❑ Inspect the oil lines and heat exchanger for leaky connections, cracks, or other damage. Replace damaged lines.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.

Troubleshooting

Troubleshooting Chart

The following chart is intended as a guide for determining the cause of problems that could be encountered and the corrective actions for those difficulties.

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Tables begin on the next page.

Table 8. Troubleshooting Chart

Symptom	Cause		Remedy	
1. Low main oil pressure	1-1	Partially clogged oil strainer	1-1	Remove and clean oil strainer.
	1-2	Stuck pressure regulation piston.	1-2	Disassemble the valve and clean the piston.
	1-3	Broken piston rings on clutch shaft(s).	1-3	Remove the collector and inspect piston rings.
	1-4	Damaged or worn oil pump assembly.	1-4	Replace damaged or worn oil pump assembly (pump is not serviceable)
	1-5	Incorrect linkage adjustment to control valve assembly.	1-5	Adjust linkage so that control valve stem is indexed properly by detent.
	1-6	Clogged or plugged orifice in orifice plate of control valve assembly.	1-6	Remove orifice plate cover. Clean parts.
	1-7	Shimming required between regulator springs and rate-of-rise piston.	1-7	Shim as required.
	1-8	Engine idle speed too low.	1-8	Raise engine speed.
2. No oil pressure, or erratic low pressure at control valve tap.	2-1	Oil pump suction strainer plugged.	2-1	Remove and clean strainer.
	2-2	Oil level low.	2-2	Check oil level and correct.
	2-3	Air leak on suction side of pump.	2-3	Correct cause of air leak.
	2-4	Pump drive on reverse clutch shaft broken.	2-4	Disassemble and repair as required.
	2-5	Regulating valve stuck in open position	2-6	Remove, disassemble, clean and repair the regulating valve.
	2-6	Oil pump defective	2-7	Replace oil pump.
	2-7	Leaking heat exchanger has caused oil to be lost over board.	2-7	Replace heat exchanger

Table. 8. Troubleshooting Chart (continued)

Symptom	Cause		Remedy	
3. High main oil pressure.	3-1	Regulating valve stuck.	3-1	Remove and clean regulating valve.
	3-2	Improperly shimmed.	3-2	Shim as required.
	3-3	Lube relief valve malfunction.	3-3	Inspect, repair or replace parts as necessary.
4. High temperature.	4-1	Improper oil level.	4-1	Check and fill (or drain) with proper oil to the correct level.
	4-2	Faulty heat exchanger	4-2	Inspect, repair, or replace heat exchanger.
	4-3	Clutches slipping	4-3	Check clutch apply oil pressure. If pressure is normal, remove, disassemble, and repair slipping clutch.
	4-4	Bearing failure.	4-4	Overhaul marine transmission.
	4-5	Air leak on suction side of pump.	4-5	Inspect and correct cause of suction leak.
	4-6	Control valve malfunction	4-6	Inspect, repair, or replace control valve.
5. Excessive Noise	5-1	Bearing failure.	5-1	Overhaul marine transmission.
	5-2	Worn or damaged input coupling.	5-2	Remove marine transmission. Replace a worn or damaged coupling.
	5-3	Excessive torsional vibration.	5-3	Select proper torsional coupling.
	5-4	Worn or damaged gears.	5-4	Overhaul marine transmission.
	5-5	Improper alignment.	5-5	Check alignment of engine and transmission output flange to propeller shaft. Correct as necessary.
	5-6	Damaged propeller.	5-6	Repair propeller.
	5-7	Misfiring engine.	5-7	Repair engine.

Table. 8. Troubleshooting Chart (continued)

Symptom	Cause		Remedy	
6. No neutral.	6-1	Clutch plates warped.	6-1	Remove clutch plates. Overhaul unit.
	6-2	Control valve incorrectly indexed.	6-2	Check and adjust control linkage.
	6-3	Solenoid malfunction (units equipped with electric selector valve)	6-3	Replace defective solenoid.
	6-4	Hydraulic lock piston stuck (units equipped with electric selector valve and hydraulic lock).	6-4	Inspect, repair, or replace hydraulic lock spool.
7. Harsh engagement.	7-1	Regulating piston or rate-of-rise piston stuck.	7-1	Disassemble control valve. Clean parts. Replace parts if necessary.
	7-2	Orifice plate ball in control valve not seating properly.	7-2	Remove orifice plate cover. Clean parts. Replace parts if necessary.
	7-3	Blown gasket on either side of orifice plate.	7-3	Replace gasket.
8. Low lube oil pressure.	8-1	Pump flow output too low.	8-1	Replace pump.
	8-1	Pump suction strainer plugged.	8-2	Remove, clean, inspect, and install the suction screen.
	8-3	Air leak on suction side of pump.	8-3	Inspect and correct cause of suction leaks.
	8-4	Lube relief valve malfunction.	8-4	Remove and clean or replace parts as necessary.
	8-5	Broken piston rings.	8-5	Replace damaged piston rings.
9. Oil spilling out of breather.	9-1	Oil level too high.	9-1	Adjust oil level.
	9-2	Wrong type of oil.	9-2	Draw and refill with recommended oil.

Disassembly

The following procedure is for complete disassembly of the unit. Prior to this procedure, the transmission should be removed from the boat. Qualified personnel should do the work in a fully equipped facility.

Note: The MG-5222DC transmission requires the use of a SKF THAP 300 oil Injection Kit (see Special Tools) or similar device to remove the output gear from the output shaft.

Prepare Transmission for Disassembly

Note: During service of this unit, all O-rings, gaskets and seals must be replaced. It is good practice to keep the old O-rings, gaskets and seals with the appropriate components being disassembled for future reference during the inspection and assembly process (to make sure you don't forget the quantity, size, etc.).

Drain the oil from the transmission sump by removing the M33x2 hex plug from the bottom of the rear side of the housing. Drain the oil from the filter housing as well by removing the O-ring plug located below the oil hose coming back from the heat exchanger.

The physical size and weight of many of the parts for this transmission assembly are such that adequate lifting devices and procedures are necessary for safety considerations. This requires that the transmission assembly be adequately supported and properly positioned as identified in the following paragraphs.

Remove Transmission External Components and Sub-Assemblies

1. Remove the oil filter element.

2. Remove the control valve and gasket. Set it aside for later disassembly.

3. Remove torsional coupling from spline on primary shaft (if not previously removed).

4. Remove front housing from main housing.

5. Remove top cover assembly and gasket.

6. Remove the oil pump and gasket.

7. Remove hex head capscrew securing clamp plate for suction strainer cover. Remove clamp plate, suction strainer cover with O-ring, and suction strainer.

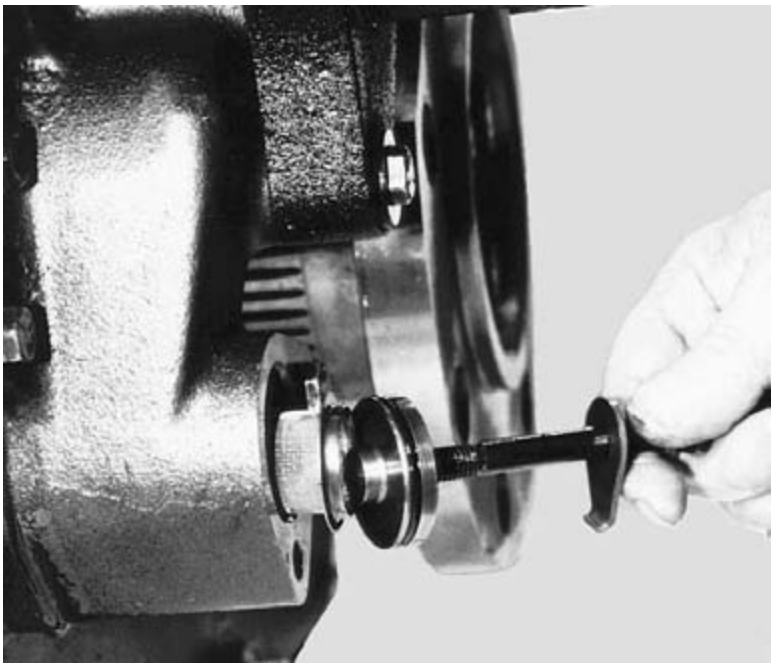


Figure 26. Removing Suction Strainer Cover

Remove Output Flange

Note: It is necessary to block and support the transmission with the output side facing up. Use caution to avoid damaging the spline on the primary shaft.

1. Remove the output flange retaining capscrews. Use one of the removed screws as a pusher screw in the center of the washer if necessary. Remove the retaining washer, shims and O-ring.

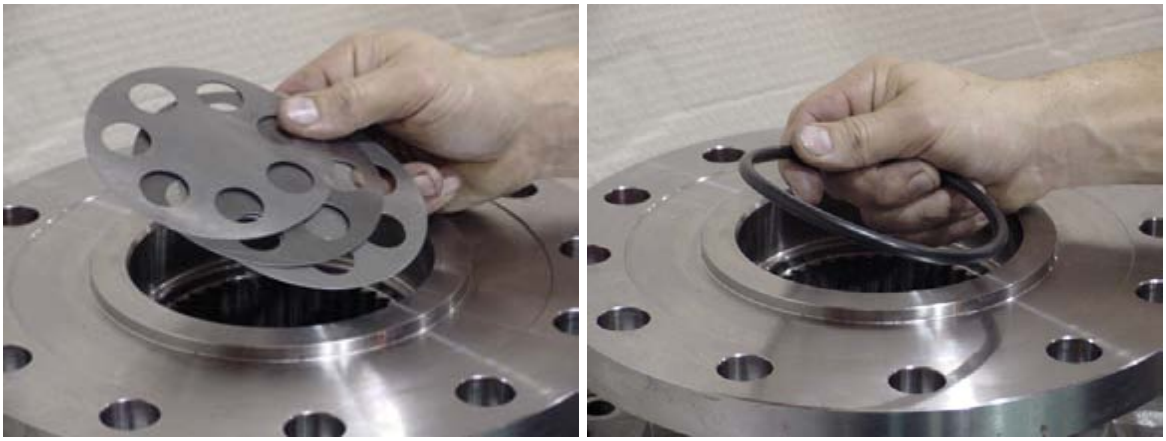


Figure 27. Removing Shims (left) and O-ring (right)

2. Use hydraulic ram to pull the output flange from the output shaft.

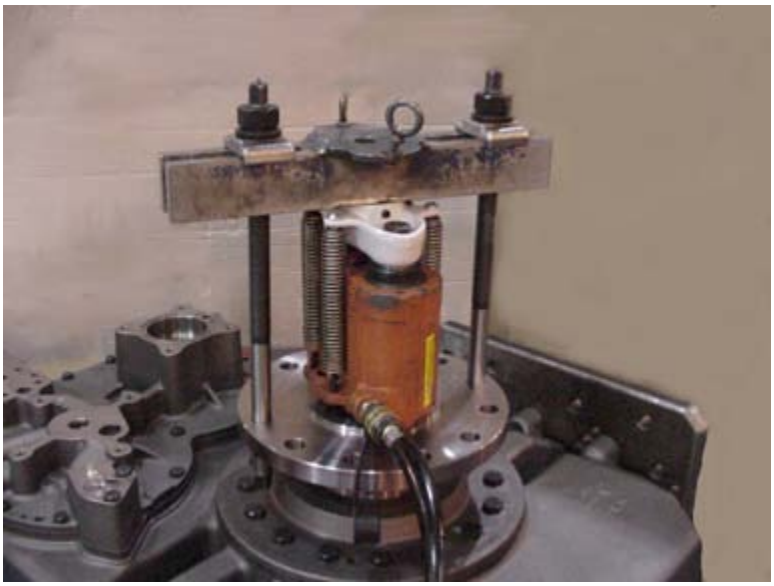


Figure 28. Removing Output Flange

Remove and Disassemble Manifold and Bearing Carrier

1. Remove the four primary shaft end cover attaching screws. Remove cover and O-ring.

2. Remove capscrews securing manifold and bearing carrier to housing.

3. Use two of the removed screws as pusher screws to separate manifold from bearing carrier and dowel pins. Remove manifold and gasket.

4. Remove bearing shims and spacers from bearing bores in bearing carrier for primary and secondary shafts.

5. Remove lubrication tube from bearing carrier.

Figure 29. Lube Tube Located in Bearing Carrier

6. Use two of the removed screws as pusher screws again to separate bearing carrier from housing. Remove bearing carrier and gasket.

7. Remove tapered roller bearing cups from bearing carrier for rear bearings for primary and secondary shafts.

8. Remove lube relief valve housing, relief valve spring and steel ball from bearing carrier.

9. Remove hex head O-ring plug, compression spring, and steel ball from manifold (located on opposite side of filter).

10. Remove the remaining O-ring plugs from manifold and housing.

Remove Primary and Secondary Shafts

1. Lift out primary and secondary shafts. (Disassembly of the primary and secondary shafts are covered later in this section.) Use caution with the front pinion bearing cones. They are loose on the pinion diameter, and should remain in the housing. On some ratios, the diameter of the output gear will allow the bearing to come out with the shaft, and it could easily fall off causing damage. Set the shafts aside for further disassembly.

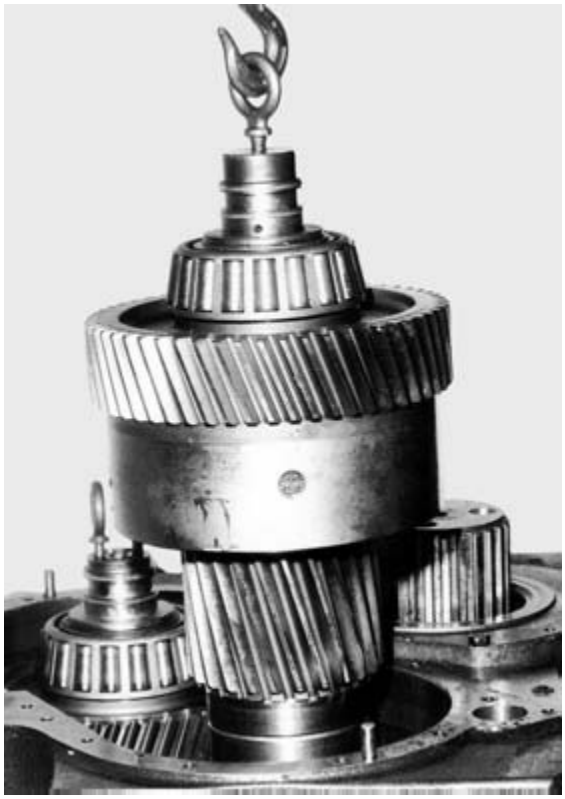


Figure 30. Lifting out Primary or Secondary Clutch Shaft Assembly

2. Remove front pinion tapered roller bearing cones that were pulled off by output gear as primary and secondary shafts were removed.

   Note: Tapered roller bearing cups of front bearings on the primary and secondary shafts are an interference fit in the housing. Removal of these bearing cups should not be attempted unless replacement of the bearing is necessary.

3. Remove oil gauge and oil gauge tube assembly.

Remove Output Shaft and Gear

1. Remove output shaft seal carrier. Use two of the removed screws as pusher screws to separate seal carrier from housing. Remove O-ring and oil seals from seal carrier.

Figure 31. Removing Output Shaft Seal Carrier

2. Remove output shaft bearing adjustment shims from housing.

3. Use a hoist to lift output shaft and gear assembly until gear contacts housing. Place blocks under gear to support the gear and shaft assembly in position.

Figure 32. Supported Shaft Assembly

4. Connect oil injection equipment to the 1/4 - 19 BSP threaded port on the rear end of the output shaft.

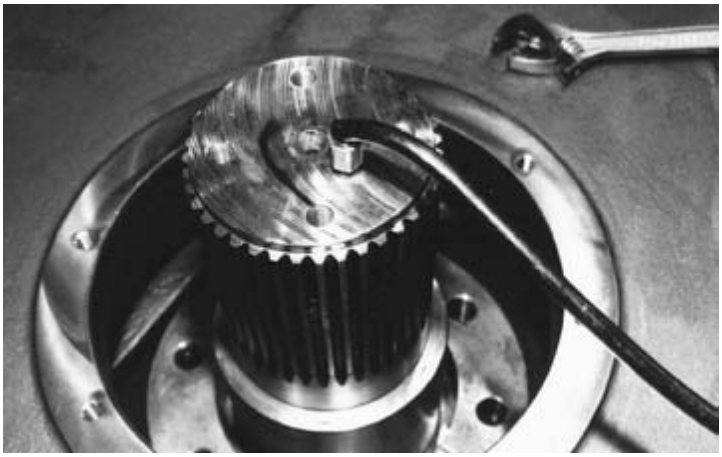


Figure 33. Oil Injection Equipment Connected

5. Install eyebolts into the end of the output shaft and into the main housing mounting pads.

6. Thread a heavy strap through the eyebolts in the output shaft and the strap to the eyebolts in the main housing. The strap will restrain the output shaft during disassembly.

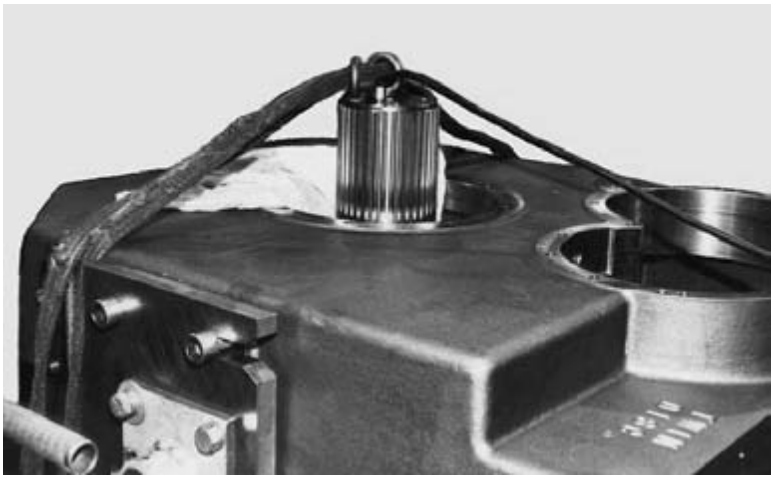


Figure 34. Safety Strap Installed

⚠ WARNING

Always use a safety strap to hold parts being separated with oil pressure. Parts may separate with extreme force.

7. Inject oil with a viscosity of 900 mm^2/S (900 cSt) at room temperature (dismounting fluid) into the output shaft until the shaft and gear separate. Remove the output shaft, gear, and front output bearing cone. Use special tool T-19987 to remove gear from housing.

8. Tapered roller bearing cups for front bearings on primary pinion, secondary pinion, and output shaft are an interference fit in their respective bearing bores. Remove these bearing cups only if replacement is required. To remove these bearing cups, weld a light bead around the I.D. of the bearing cup with an electric welder. This will shrink the cup and facilitate removal. Bearings removed in this manner must be replaced.

9. Remove input oil seal. Remove input oil seal protector plug if replacement is necessary.

Disassembly of Primary Shaft or Secondary Shaft (Disassembly of Secondary Shaft is Described)

1. Remove two piston rings from rear end of shaft.

2. If rear bearing must be removed, remove bearing retaining ring from rear end of shaft. Remove the bearing as follows:

   Note: Do not remove rear bearing unless bearing must be replaced. Bearing is an interference fit with shaft and will be destroyed during removal.

   A. With a hammer and chisel, cut cage off bearing to remove bearing cage and rollers.

   B. Use a split-type bearing puller (cheese cutter) to grip flange at small end of tapered inner race.

   C. With a hydraulic jack, pull on bearing inner race while pushing on rear end of shaft to remove bearing inner race from shaft.

3. Set shaft upright with input end up.

4. Remove and disassemble pinion(s).

   A. Remove round retaining ring from input end of shaft and remove pinion from shaft.

   B. Remove internal retaining ring from input end of pinion and remove straight roller bearing.

   Note: The straight roller bearing in the bore of the input end of the pinion is a tight fit, and will likely be destroyed during removal. Remove the straight roller bearing with the use of a puller behind the roller ends.

Figure 35. Removing Round Retaining Ring From Input End Of Shaft

   C. Remove tapered roller bearing outer race from bore at rear of pinion if bearing requires replacement. This bearing race is an interference fit in the pinion bore. To remove, use an electric welder to weld a light bead around the I.D. of the bearing race. This will shrink the bearing cup to facilitate removal. Bearings removed with this method must be replaced.

5. Remove tapered roller bearing inner race from shaft. (Bearing supports rear of pinion.) This bearing is a slip fit and should remove easily.

6. Remove internal retaining ring at front of clutch housing and remove clutch backing plate.

7. Remove clutch plates (10 steel, 11 friction), maintaining the respective order for inspection purposes.

8. Remove clutch apply piston.

   A. Place clutch in a press, input side up. Use special tool T-19998 to compress clutch release springs and expose round retaining ring.

Figure 36. Removing Retaining Ring From Spring Retainer

   B. Remove retaining ring. Slowly release pressure on press and remove shaft from press. Remove special tool T-19998 and spring retainer. Remove clutch release springs form pockets in face of piston.

C. Carefully apply compressed air to hydraulic pressure port to force piston from piston bore. Remove clutch piston.

Figure 37. Removing Clutch Piston

D. Remove piston ring from ring groove in shaft (seals I.D. of clutch piston) and piston ring from ring groove in O.D. of clutch piston.

Note: Do not separate clutch housing/transfer gear from the secondary shaft unless the shaft or the clutch housing must be replaced and the mating part remains serviceable. Use the following procedure to separate the housing/transfer gear from the primary or secondary shaft :

9. To remove clutch housing, place shaft and clutch housing on a press, front end of shaft down. Place a sleeve over input front end of shaft with an I.D. only slightly larger than the O.D. of the shaft taper large end [95.25mm (3.75 in.)]. Rest one end of sleeve on a heavy wood block while the other end supports the inner face of the clutch housing. Apply press force to rear end of shaft to separate shaft from clutch housing. The shaft must be protected and restrained to prevent damage as the tapered joint separates.

Selector Valve Disassembly -- Mechanical Valve

⚠ CAUTION

Steel ball is under pressure from the spring. Care must be taken when removing the cover and orifice plate to prevent loss of steel ball.

1. Remove the orifice plate cover, orifice plate, and check ball.

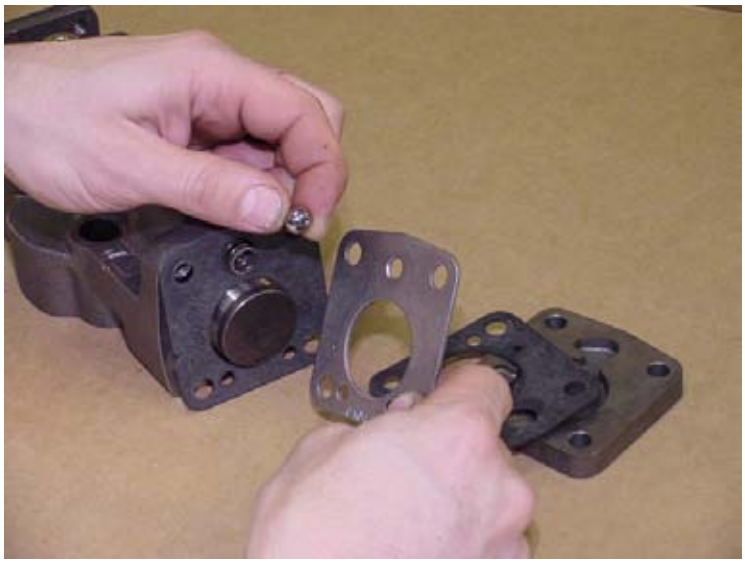


Figure 38. Removing Orifice Plate and Check Ball

2. Remove the check ball spring and shim(s) from the valve body.

Figure 39. Removing Check Ball Spring

3. Remove the rate-of-rise piston and remove the pressure regulator adjustment shims from the rate-of-rise piston.

Figure 40. Removing Shims from Rate of Rise Piston

4. Remove the pressure regulating springs and pressure regulator piston

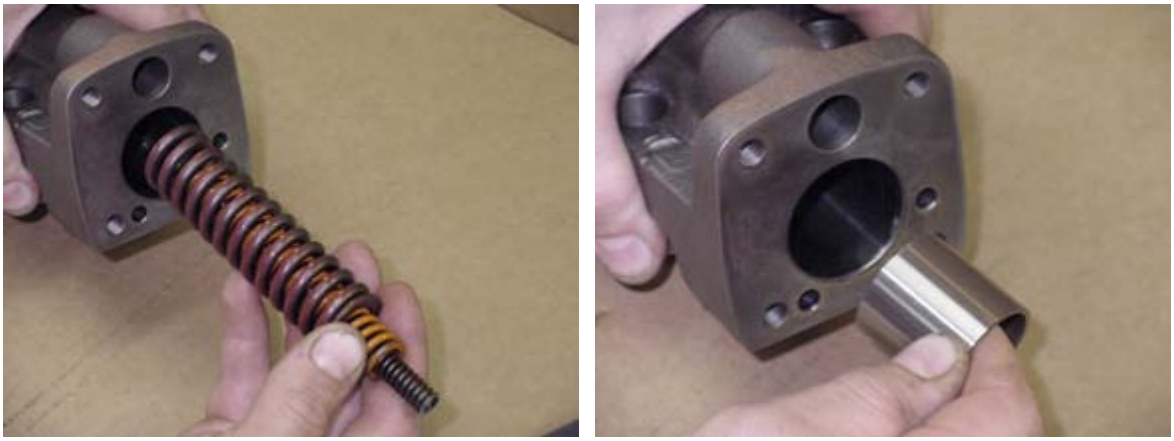


Figure 41. Removing Regulator Springs and Regulator Piston

5. Remove the O-ring plug, detent spring, and detent ball.

Figure 42. Removing O-ring Plug, Detent Spring and Ball

6. Mark the lever and the stem to indicate the position the lever was installed on the stem. Loosen the screw clamping the lever to the stem and remove the lever. It may be necessary to splay the lever to be able to remove it. DO NOT apply any impact force to the lever, as the stem, lever, or bearing might get damaged.

Figure 43. Removing Lever

7. Remove the cover and stem together as a unit.

Figure 44. Removing Stem and Cover Together

8. Mark the stop collar and the stem to indicate the position the collar was installed on the stem. While supporting the collar, drive the roll pin out of the collar with a drift punch and remove the collar.

Figure 45. Removing Roll Pin and Stop Collar

9. Slide the stem out of the cover.

10. Remove the oil seal from the cover.

11. Remove the O-ring from the stem.

Figure 46. Removing O-ring from Stem

12. Remove the thrust bearing and races from the stem.

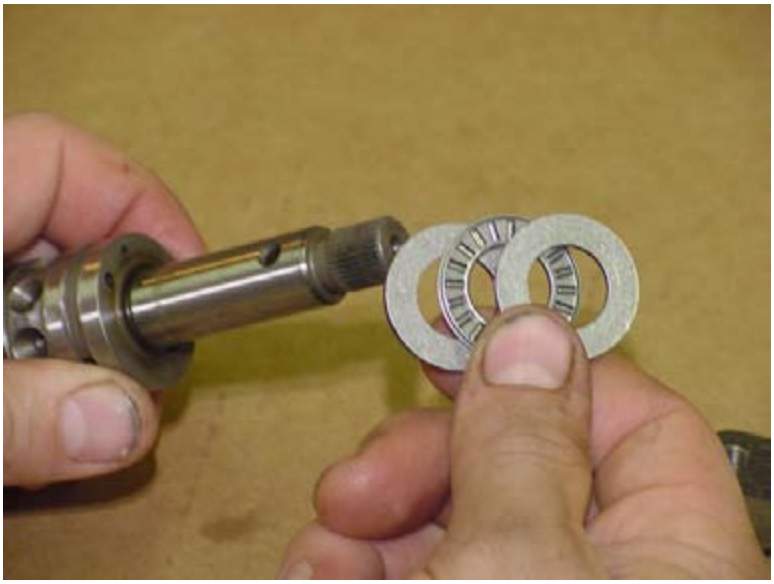


Figure 47. Removing Thrust Bearing and Races from Stem

13. Remove the remaining plugs from the valve body.

Selector Valve Disassembly -- Electric Valve

⚠ CAUTION

Steel ball is under pressure from the spring. Care must be taken when removing the cover and orifice plate to prevent loss of steel ball.

1. Loosen and remove four of M8 x 25 socket head capscrews, and remove orifice plate cover and gasket.

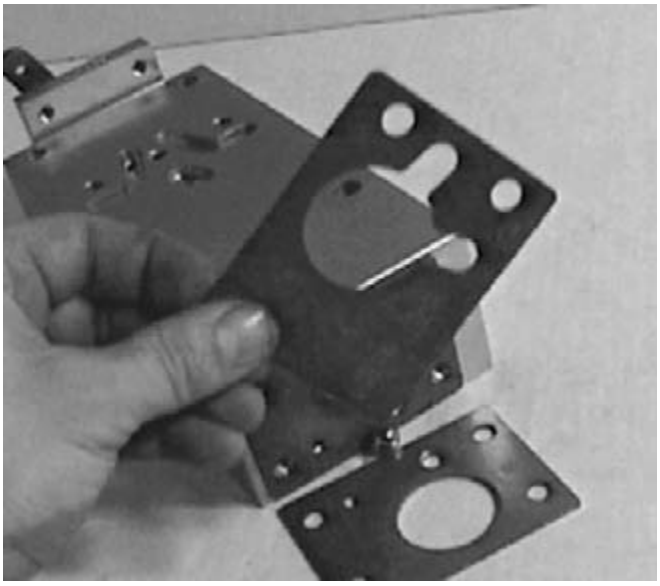


Figure 48. Removing Orifice Plate Cover Gasket

2. Remove orifice plate.

3. Remove steel ball and neutral pressure regulating spring.

4. Remove orifice plate gasket.

5. Remove rate-of-rise piston. Note that shims are located between the piston and springs.

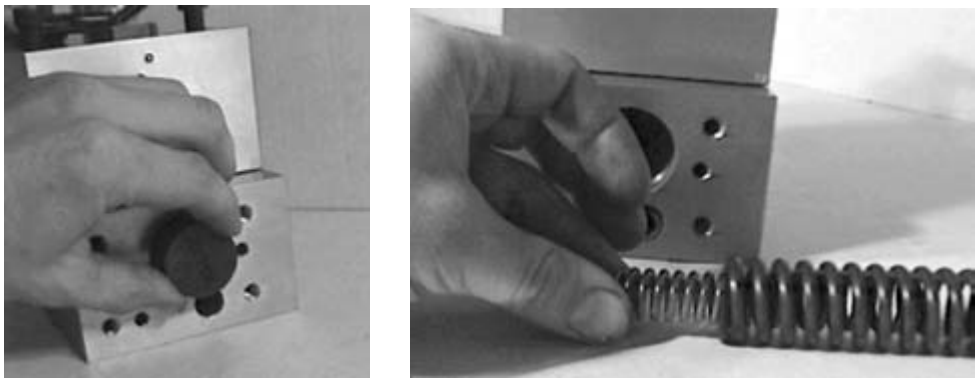


Figure 49. Rate of Rise Piston (left) and Regulator Springs (right)

6. Remove pressure regulating springs.

7. Remove pressure regulating piston with an external retaining ring pliers.

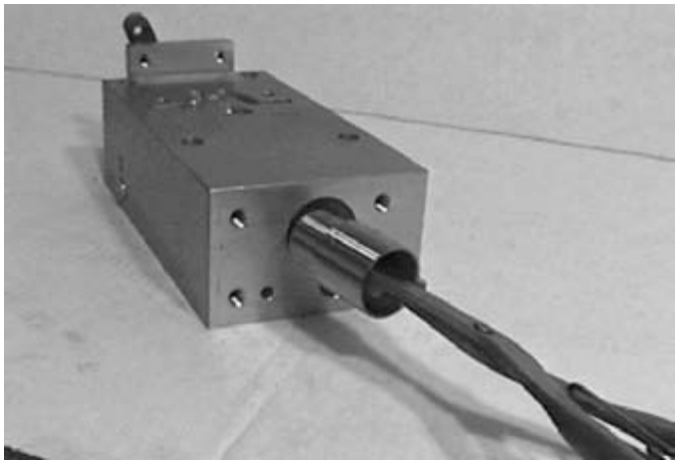


Figure 50. Removing Regulating Piston with Pliers

8. Remove external retaining ring from the lever end of the stem.

9. Loosen the clamping nut and remove the control lever from the stem. It may be necessary to splay the lever to be able to remove it. DO NOT apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

10. Remove the washer and spring from the stem.

11. Remove four of M8 x 25 socket head capscrews.

12. Remove the cover assembly with gasket from the valve body.

13. Remove the O-ring and oil seal from the cover assembly.

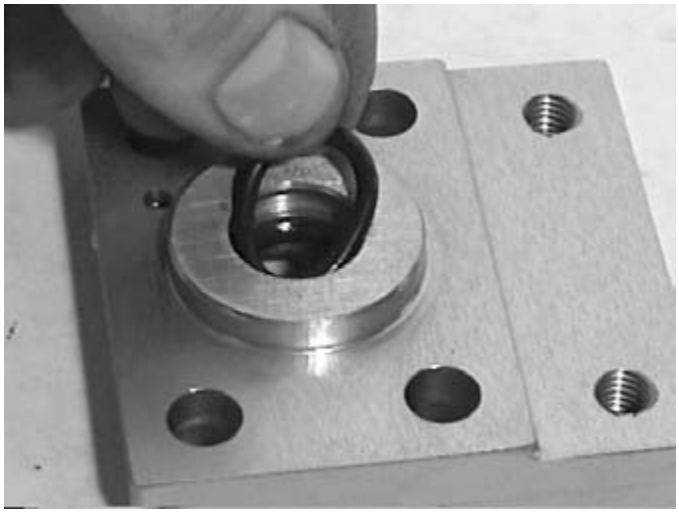


Figure 51. Removing O-ring from Cover

14. Remove the two electrical switches from the sides of the valve body and the two steel balls from each of the switch bores in the valve body (some models).

15. Remove the detent setscrew, spring, and steel ball from the valve body.

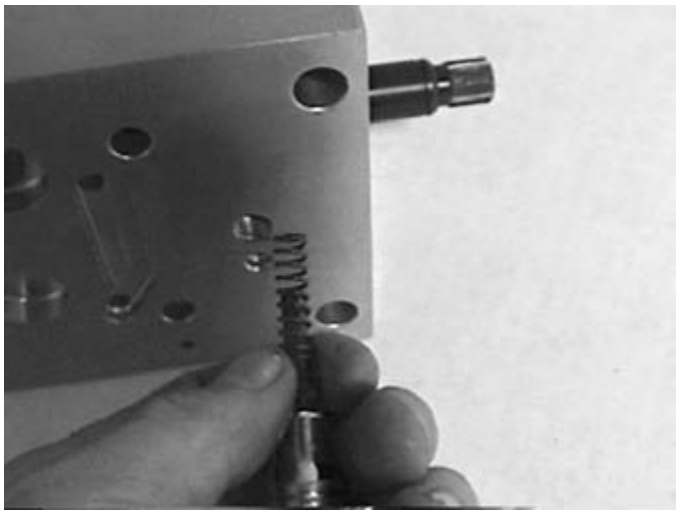


Figure 52. Removing Detent Setscrew and Spring

16. Remove the dog-point setscrew. Note that the setscrew is retained with MA908 threadlocker.

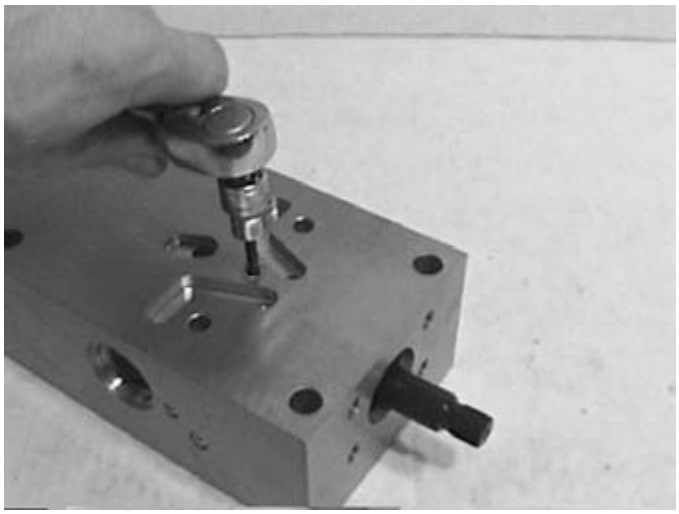


Figure 53. Removing Dogpoint Setscrew

17. Remove the stem from the valve body partially.

18. Remove the thrust washer from the stem.

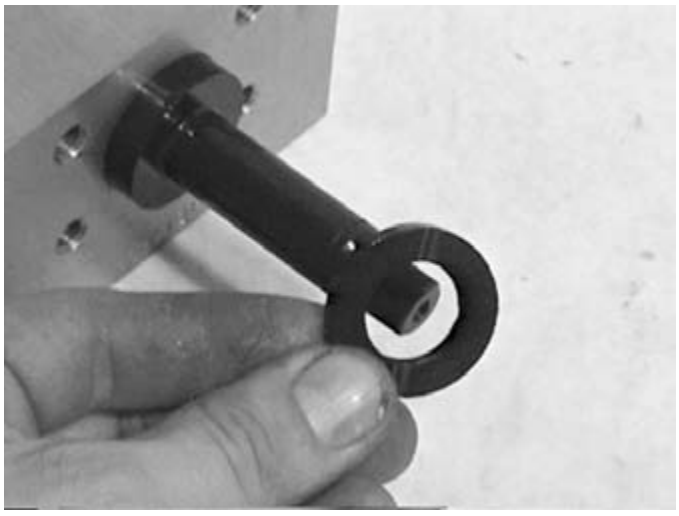


Figure 54. Removing Thrustwasher

19. Remove the stem from the valve body.

20. Remove the roll pin (retains the shuttle ball seat) with a needle-nose pliers.

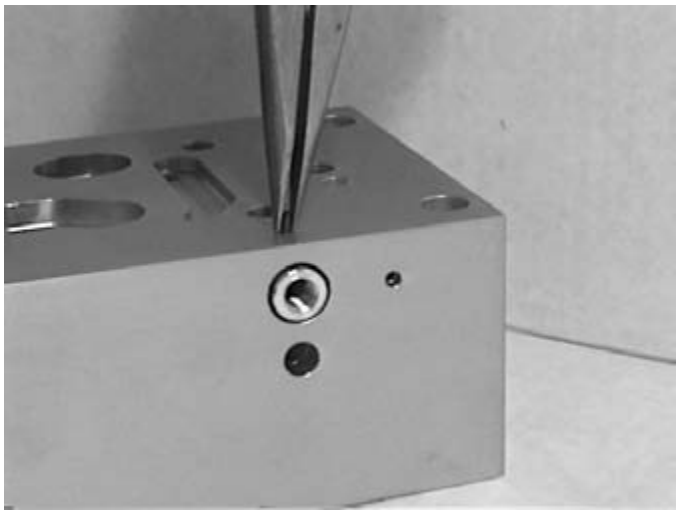


Figure 55. Removing Roll Pin Retaining Shuttle Seat

21. Thread a M8x1.25 screw (one of the cover screws works well) into the seat and remove it from the valve body.

22. Remove the shuttle ball from the valve body.

Disassembly of Upper Valve Body Half (electric section)

1. Remove the Weatherpak connector from the valve body by sliding it in the direction of the opening in the shroud.

2. Mark the wires with the location letters that are on the Weatherpak connector. Open the end of the Weatherpak connector to allow removal of the pins and wires.

3. Remove the pins (for the wires of all but one solenoid) from the Weatherpak connector using the extraction tool. Tool is Packard Electric P/N 12014012.

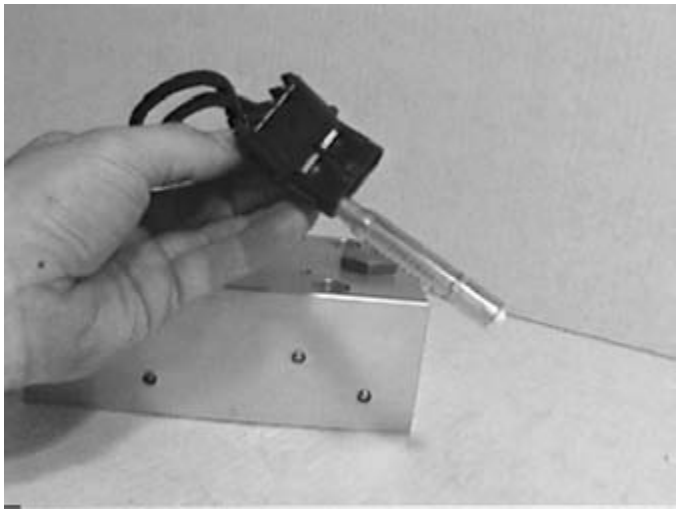


Figure 56. Removing Wires using Extraction Tool

4. Mark the two solenoids for location identification and remove them.

5. Remove the third (Neutral) solenoid (units with hydraulic lock) or plug (units without hydraulic lock).

6. Remove the filter screen from the valve body.

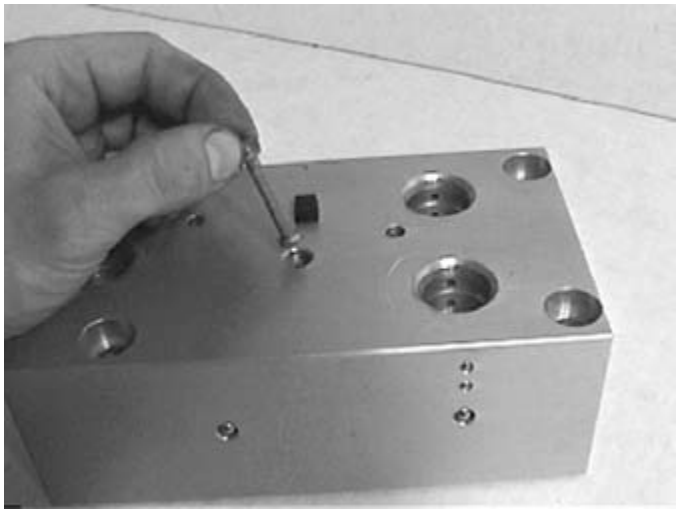


Figure 57. Removing Filter Screen

7. Remove the two socket head O-ring plugs from the bores in the end of the valve body.

8. Remove the two spools from the valve body.

9. Remove one dowel pin and spring from each of the spools (hydraulic lock units only).

10. Remove the spool return spring and dowel pin from the bottom of each of the spool bores in the valve body.

1017555 Trolling Valve (Optional Equipment)

1. Remove the trolling valve attaching screws.

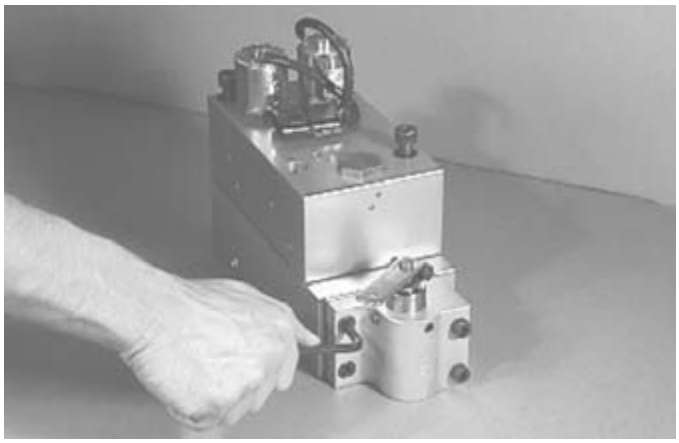


Figure 58. Removing Trolling Valve Attaching Screws

⚠ CAUTION

Steel ball is under pressure from the spring. Care must be taken when removing the trolling valve and orifice plate to prevent loss of steel ball.

2. Remove the trolling valve from control valve.

3. Remove the gaskets, orifice plate, and steel ball from control valve.

4. Remove the screw and nut clamping the lever to the stem.

5. Remove the lever from the stem. It may be necessary to splay the lever to be able to remove it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

6. Remove the detent setscrew, spring, and detent ball.

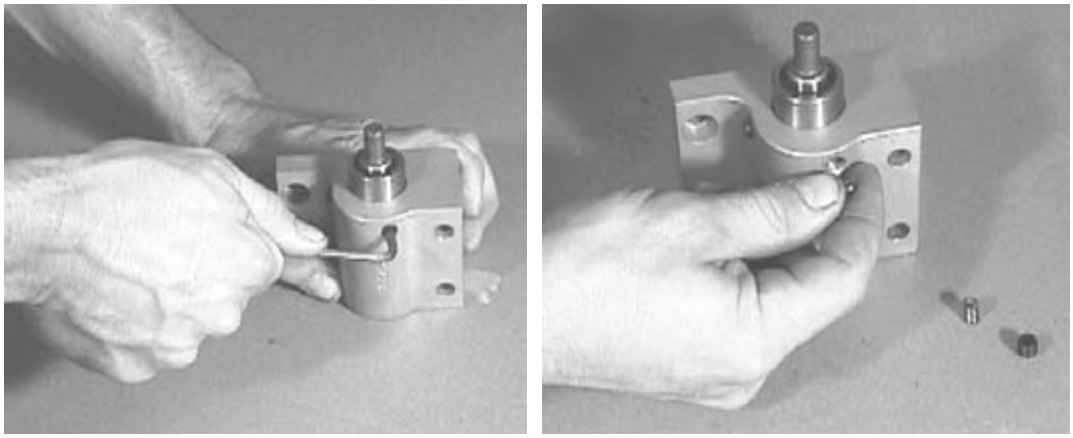


Figure 59. Removing Detent Setscrew (left) and Detent Spring and Ball (right)

7. Remove the dog-point setscrew from the valve body.

Figure 60. Removing Dog-point Setscrew

8. Slide the stem and adapter out of the valve body together as one piece. Push the stem out of the adapter such that the spring end of the stem exits the adapter first. Note that the inner spring will come out with the stem.

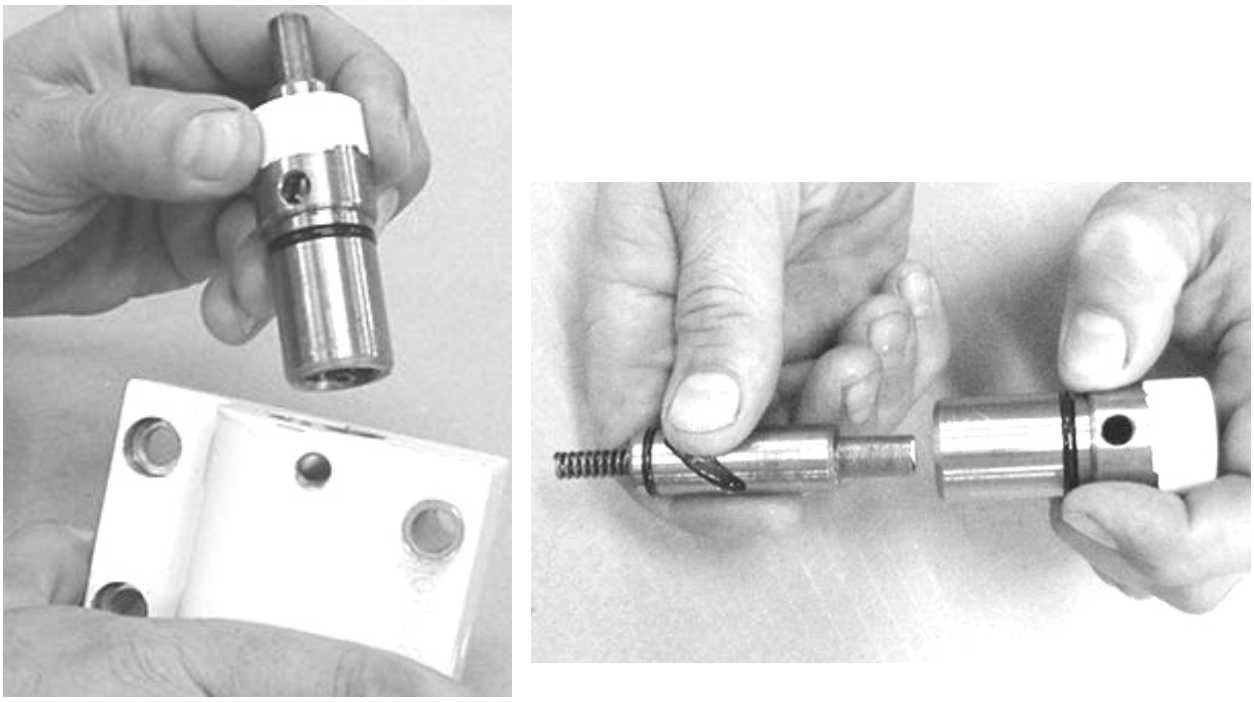


Figure 61. Removing Stem and Adapter from Valve Body (left) and Removing Stem from Adapter (right)

9. Remove the O-ring from the groove in the end of the stem.

Figure 62. Removing O-ring From Stem

10. Remove the inner spring and roll pin from the stem only if replacement of parts is necessary.

11. Remove the washer from the bore of the valve body (some models). Note: the washer may have been removed with the stem.

12. Remove the (outer) spring and piston from the bore of the valve body. Note that there may be washer(s) in the bore of the piston (some models).

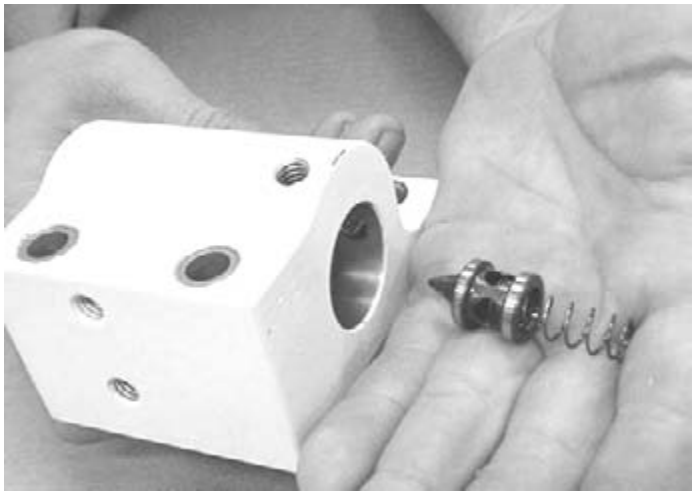


Figure 63. Removing Spring and Piston from Valve Body

13. Remove the O-ring from the groove and the oil seal from the end of the adapter.

Figure 64. Removing O-ring From Adapter

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings piston rings, seal rings, snap rings, etc., as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

- ❑ Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must be dried and oiled immediately to prevent corrosion.
- ❑ Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.
- ❑ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ❑ Use clean solvent to flush oil pumps, valves, etc.
- ❑ Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.
- ❑ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

Do not remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

⚠ CAUTION

Never dry bearings with compressed air. Do not spin unlubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

- ❑ For previously sealed joints, scrape surfaces to remove old gasket material or silicone.
- ❑ Clean surfaces with solvent to remove oil and grease residue.
- ❑ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ❑ Replace cast parts or housings that are cracked.
- ❑ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding. This will cause loss of press of bearings or races.
- ❑ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ❑ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ❑ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ❑ Inspect ground tapers for scratches, galling or scoring damage. If any of these the defects, replace the part.
- ❑ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ❑ Inspect studs for damaged threads and looseness. Replace defective studs.
- ❑ Inspect dowel pins for wear or damage. Replace defective dowels. This applies where a matched set of parts is not involved.
- ❑ Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings

- ❑ Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.
- ❑ Inspect bearings for corrosion, and for indication of wear of balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. If you find one of these defects, replace the bearing.
- ❑ Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust Washers and Spacers

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears

- ❑ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ❑ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ❑ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found. Refer to wear limits in Description and Specifications.

Assembly

The MG-5222DC transmission requires the use of a SKF THAP 300 Oil Injection Kit (See Special Tools) or similar device to install the output gear onto the output shaft.

Unless otherwise specified, all torque values listed are for capscrews that have been lubricated on the threads and contact surfaces.

The following discussion contains frequent reference to the transmissions parts and components. Refer to Engineering Drawings.

Prior to Assembly

Use the following reference: The input side of the transmission is the front and the output side is the rear. Left and right sides are determined by facing the output side of the transmission from the rear.

Identify and place the following bearing components in an oven at 120˚C (250˚F) for 30 minutes: output shaft rear tapered roller bearing cone and the rear bearing cones for both clutch shafts.

Submerge all new friction clutch plates in transmission oil for a minimum of one hour prior to installation.

Identify and place the following bearing components in a deep freeze -51˚C (-60˚F) for at least two hours prior to assembly: both output bearing cups, all pinion bearing cups, and both pinion inner needle roller bearings.

Preliminary Assembly

1. Lay the transmission on blocking with the rear side up.

2. Install the seal protector into input shaft front bearing area using a soft hammer.

Figure 65. Seal Protector Installation

3. Install the chilled cups for the primary and secondary front tapered roller bearings into their respective bores in the front inner face of the housing. Use driver T-18050-610 to press/drive cups to the bottom of the bore. It is important to maintain downward force as temperatures equalize to ensure that cup is at bottom of bore.

Figure 66. Front Pinion Bearing Cup Installation

4. Measure and record the distance from the machined surface of the housing to the bottom of the bearing cup bore where the oil shield contacts (dimension “A”). Measure and record the thickness of the oil distribution shield at the outer edge (dimension “B”). Measure and record the width of the bearing cup (dimension “C”).

5. Install oil distribution shield into output shaft front bearing bore. Be sure shield is properly centered.

6. Install chilled front output tapered roller bearing cup into housing bore. Use driver T-18050-611 to press/drive cup to bottom of its bore.

   Note: Care must be taken to ensure that the shield remains centered.

7. Use T-18050-772 to ensure the bearing cup is properly seated. Tighten puller rod to standard torque limit for thread size of puller rod or 275 Nm (200 ft-lb), whichever is less. Maintain this torque until bearing cup and housing temperatures equalize (approx. 10 minutes).

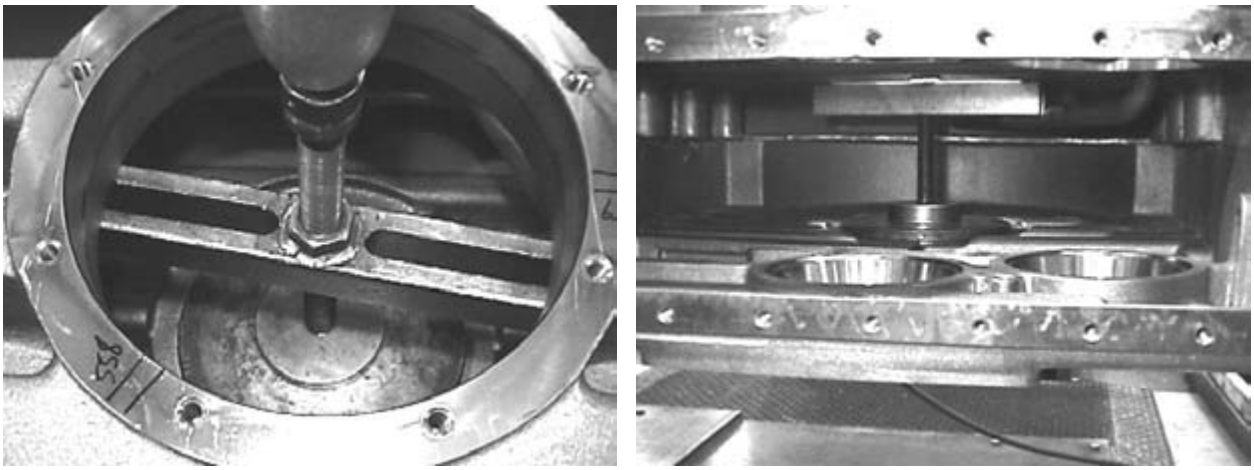


Figure 67. Installing Output Shaft Bearing Cup

8. Remove puller and steel plate. Measure and record the distance from the machined surface of the housing to the top of the bearing cup (dimension “D”). Dimension “D” must equal dimension “A” minus dimension “B” minus dimension “C” within 0.025 mm (0.001 in.).

Installation of Output Shaft and Gear

1. Clean tapered surface of output shaft and tapered bore of output gear. Use OSHA approved cleaning solvent to remove all traces of dirt, grease, oil, etc. Do not touch cleaned surfaces. Loctite® 7070 cleaner is recommended.

⚠ CAUTION

Tapered surface of shaft and matching tapered bore of gear must be completely free of grease, oil, dirt or solvent residue. Failure to properly clean mating parts could prevent proper advance measurement of gear on shaft and adversely effect torque carrying capacity of the assembled joint.

2. Install front output bearing cone and output gear. Use special tool T-19987 to position gear into correct location. Install the output shaft into the output gear and bearing cone in the transmission housing. Seat shaft onto the taper of the gear using only the weight of the shaft.

3. Use gauge blocks and a feeler gauge to measure between the output gear and shaft shoulder. This is the potential advance, and it must be 9.52 mm to 11.05 mm (0.375 in. to 0.435 in.).

Figure 68. Measuring Output Gear Advance

Note: Should the calculated advance fall outside the range given above, check to assure that all measurements and calculations are correct. If no errors are found and the expected advance is out of tolerance, it will be necessary to change parts. Contact the Product Service Department at Twin Disc, Incorporated for assistance.

4. Connect the oil injector to the output shaft.

5. Install T-20023 onto the output shaft and gear.

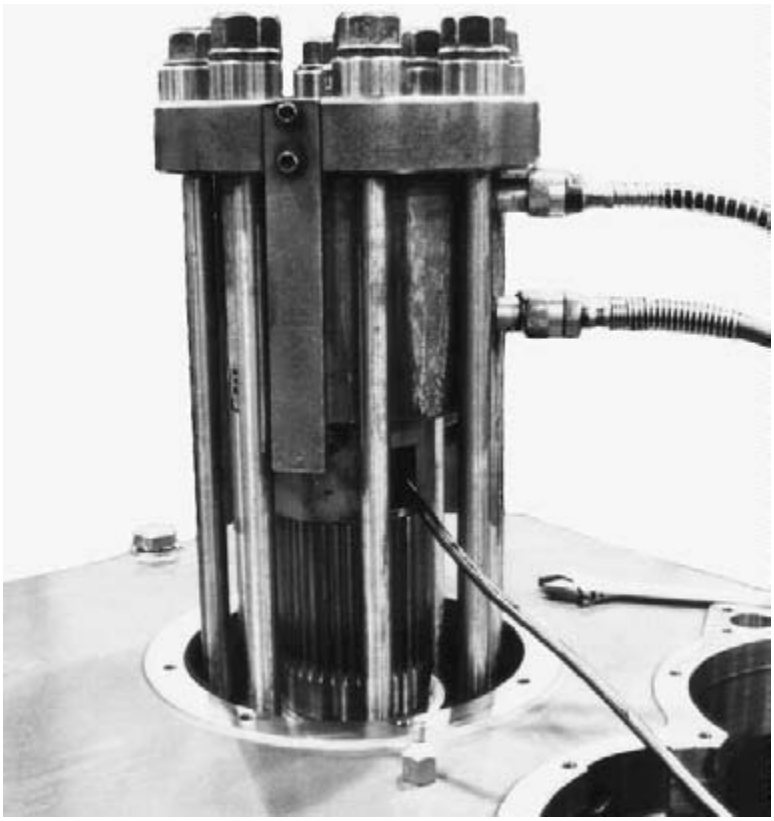


Figure 69. Output Gear Advancing Tools Installed

6. Inject oil with a viscosity of 300 mm^2/S (300cSt) at room temperature (mounting fluid) into the shaft until it leaks out of both ends of the mating surfaces.

7. Advance gear to shaft shoulder stop with the portable press.

8. Release injection oil pressure between the mating surfaces and wait five minutes before lowering the press force and removing the assembly tool.

9. Remove the assembly tools from the output shaft and gear.

10. Confirm that the output gear has been advanced completely such that there is no gap between the shaft shoulder and the gear hub.

11. Install the pinion front bearing cones for primary and secondary shafts onto bearing cups previously installed in transmission housing.

Installation of Output Shaft Rear Bearing

1. Install heated rear output shaft tapered roller bearing. Install with small O.D. of bearing to the rear. Press/drive bearing to shaft shoulder using special tool T-18050-96. After bearing cools, press/drive bearing down again to assure that bearing is against shaft shoulder.

2. Install chilled bearing cup into output seal carrier using tool T-18050-116. After bearing warms, press/drive bearing cup down to assure that bearing cup is bottomed in bore of seal carrier.

Output Shaft Tapered Roller Bearing Adjustment

1. To set output shaft bearing clearance, proceed as follows.

   A. Install seal carrier without seals or O-ring. Secure seal carrier with capscrews using very little torque on capscrews. Use a taper gauge or feeler gauge to measure gap between rear housing face and flange of output seal carrier. Build a trial shim pack of thickness equal to gap plus 0.50 mm (0.020 in.). Install the shim pack.

   B. To lift output shaft, install eyebolts and strap to rear of output shaft. Apply 1340 N to 4000 N (300 lbs to 900 lbs) of downward force on rear end of output shaft. Seat front bearing rollers by rotating shaft several revolutions with weight applied.

   C. Install dial indicator onto the housing with finger resting on rear of output shaft or on lifting fixtures. Zero the dial indicator and mark the spot where the reading was taken.

   D. Using a hoist, exert 2225 N to 4000 N (500 lbs to 900 lbs) of lifting force onto the shaft. Minimum of 2224 N (500 lbs) lifting force is required to overcome weight of gear and shaft and still exert a minimum of 1334 N (300 lbs) lifting force on bearing. Rotate shaft several revolutions with lifting force applied. Stop rotation with dial indicator finger on mark previously made, continuing to hold lifting force. Read shaft endplay on dial indicator.

   E. Make a shim pack to decrease endplay to 0.05 mm to 0.15 mm (0.002 in. to 0.006 in.). Arrange the shims so the clearance holes for the pusher screws are aligned. Install shim pack between seal carrier and housing.

   F. Repeat steps B through D until endplay is between 0.05 mm to 0.15 mm (0.002 in. to 0.006 in.).

2. Remove lifting fixture. Remove capscrews and remove output seal carrier.

3. Install O-ring in groove in O.D. of output seal carrier.

Figure 70. Installing O-ring onto Output Seal Carrier

4. Coat O.D. of seals with M2828 anaerobic sealant and install oil seals into output seal carrier using driver T-18050-120. Remove excess sealant that is wiped off as seals are pressed into position.

   A. Install forward seal with spring-loaded lip toward the inside of the transmission. Install flush with inner face of seal carrier.

   B. Install rear seal with spring-loaded lip of seal toward rear of the transmission. Install flush with outer face of seal carrier.

C. Pack area between the seals with water pump grease.

Figure 71. Packing Cavity Between Output Seals With Grease

D. Install grease fitting if not previously installed.

5. Install established shim pack, aligning pusher screw clearance holes of shims with threaded pusher screw holes of seal carrier.

Figure 72. Installing Shim Pack (left) with Pusher Screw Holes Aligned (right)

6. Install assembled output seal carrier onto housing. Install attaching screws and torque to 275 Nm (203 ft-lb).

Figure 73. Installing Seal Carrier

Installation of Top Cover Assembly and Oil Gauge

1. Turn transmission over and block securely to rest in upright position.

2. Install top cover assembly with its gasket. Install attaching screws and torque to 112 Nm (83 ft-lb).

3. Install breather-filler cap.

4. Install oil gauge tube assembly and oil level gauge. Verify that the oil gauge tube assembly did not enter the output gear pan opening.

Assembly and Installation of Primary and Secondary Shafts

1. Assembly of transfer gear to secondary shaft.

   A. Clean taper on secondary shaft and tapered bore in transfer gear using OSHA approved cleaner. Do not touch cleaned surfaces. Loctite® 7070 cleaner is recommended.

   B. Determine if secondary shaft and transfer gear can be advanced properly:

      a. Hold secondary shaft in a vertical position standing on its front end.

      b. Use a depth micrometer and measure distance from the rear end of the shaft to the shaft shoulder at small end of taper. Record this distance as dimension “A”.

      c. Install secondary transfer gear on secondary shaft taper, small diameter of tapered bore up. Seat gear on shaft taper with 445 N to 890 N (100 lbs to 200 lbs) of force.

      d. Use a depth micrometer and measure distance from rear end of shaft to machined face of transfer gear at small diameter of tapered bore. Record this distance as dimension “B”.

      e. Calculate expected advance: Expected advance = A - B. Calculated advance must be 2.84 mm to 3.86 mm (0.112 in. to 0.152 in.). If calculated advance is not within the range, recheck all measurements and calculations for errors. If no errors are found, contact the Product Service Department at Twin Disc, Incorporated for information.

   C. Set secondary transfer gear on fixture T-18050-609 with large diameter of tapered bore up. Move fixture and transfer gear to a press with at least 445 kN (50 tons) capacity.

   D. Install secondary shaft front end up, into tapered bore of transfer gear. Seat shaft in tapered bore of gear by applying 445 N to 890 N (100 lbs to 200 lbs) downward force on shaft.

E. Center fixture, gear and shaft under ram of press and apply approximately 276 kN to 409 kN (31 tons to 46 tons) of force on front end of secondary shaft. Release pressure and turn fixture, shaft and gear 180°. Reapply pressure to complete advance.

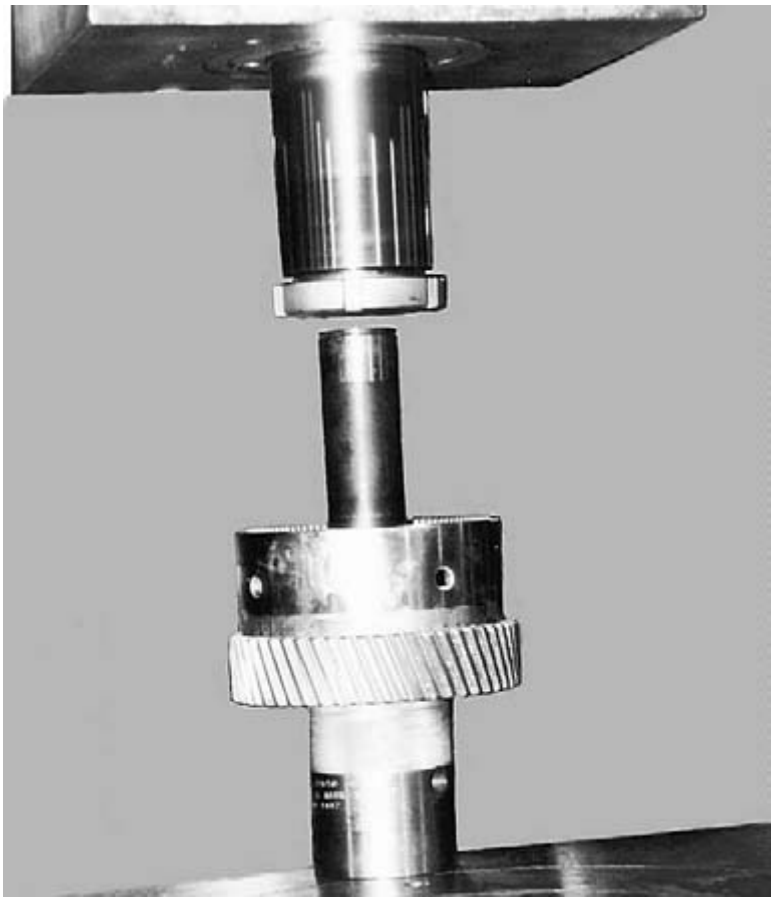


Figure 74. Pressing Clutch Shaft Into Transfer Gear

F. Using a depth micrometer, measure distance from rear end of shaft to face of transfer gear. Record as dimension “C”. Transfer gear face should be within 0.05 mm (.002 in.) of the shaft shoulder at the small diameter end of the taper.

Note: Actual advance (C-B) must be 2.84 mm to 3.86 mm (0.112 in. to 0.152 in.). If transfer gear has not been advanced as specified above, contact the Product Service Department at Twin Disc, Incorporated for information.

2. Install piston seal ring into groove in secondary shaft. Apply a coat of assembly grease or oil to seal ring.

3. Install piston ring in groove in O.D. of clutch apply piston. Apply a coat of assembly grease or oil to seal ring.

4. Install clutch apply piston into piston bore in transfer gear.

Figure 75. Installing Clutch Piston

5. Installation of clutch return springs.

   A. Install 16 clutch return spring assemblies into pockets in face of clutch apply piston. (Each assembly consists of one inner and one outer spring.)

   B. Install spring retainer over springs with groove toward springs. Working through holes in retainer, use a small punch or probe to assure that all springs are in pockets in face of piston and that springs are aligned correctly (stand straight up).

Figure 76. Return Springs and Spring Retainer Ready for Installation

C. Install external retaining ring over shaft to rest against spring retainer. Move shaft assembly to press and install tool T-19998. Press down tool T-19998 to compress springs and expose retaining ring groove of shaft. Keep force on springs and install retaining ring into exposed groove of shaft.

Figure 77. Installing Spring Retainer Retaining Ring

D. Slowly release force on springs assuring that spring retainer counterbore covers retaining ring and prevents retaining ring from coming out of the groove. Remove tool T-19998.

6. Use driver T-18050-152 and hydraulic press to press rear tapered roller bearing cone onto secondary shaft. Install bearing with large O.D. toward transfer gear and press to seat against transfer gear.

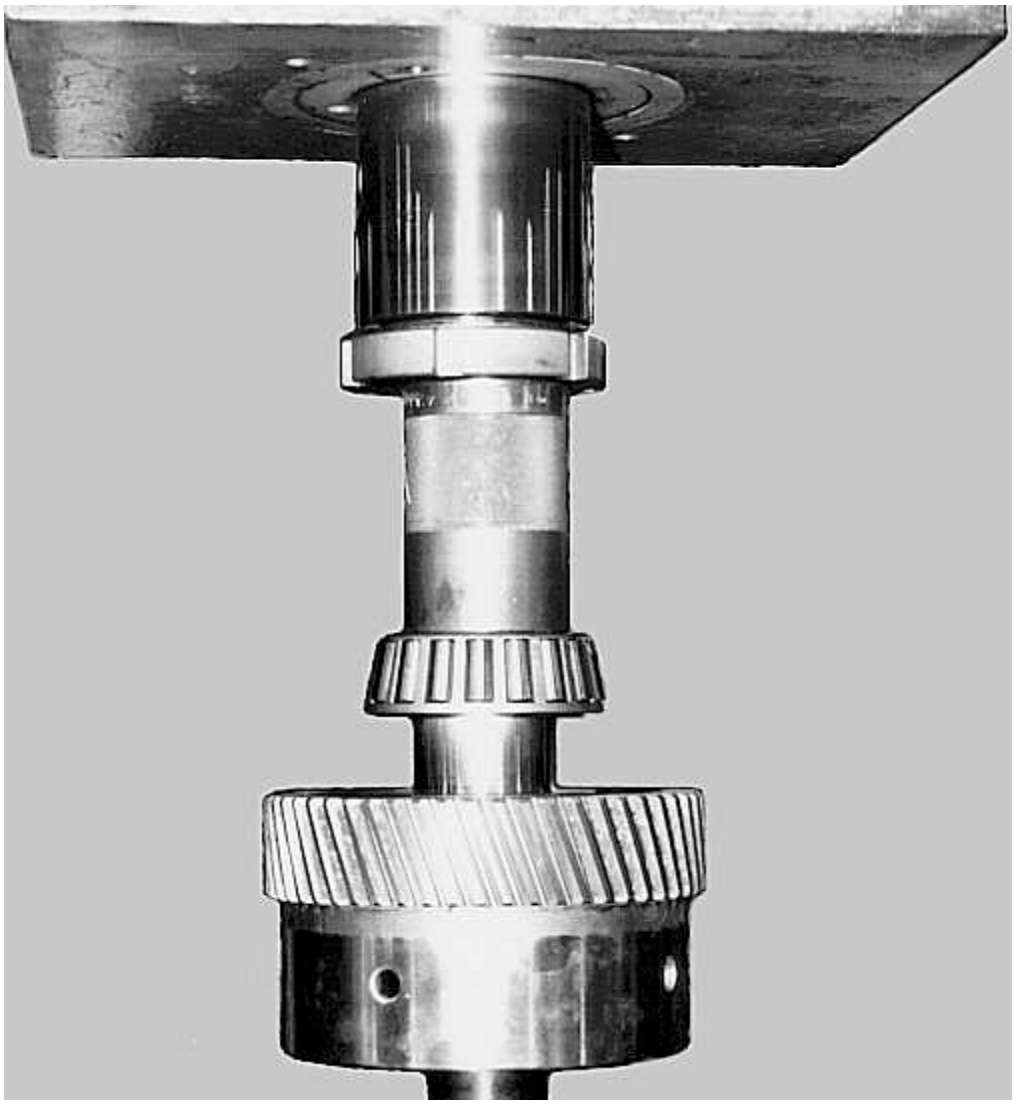


Figure 78. Installing Clutch Shaft Rear Bearing Cone

7. Install external retaining ring with tapered edge side away from bearing.

8. Beginning with a friction plate, alternately install 11 friction plates and 10 steel plates into clutch housing (transfer gear) against clutch apply piston.

9. Install clutch backplate and internal retaining ring.

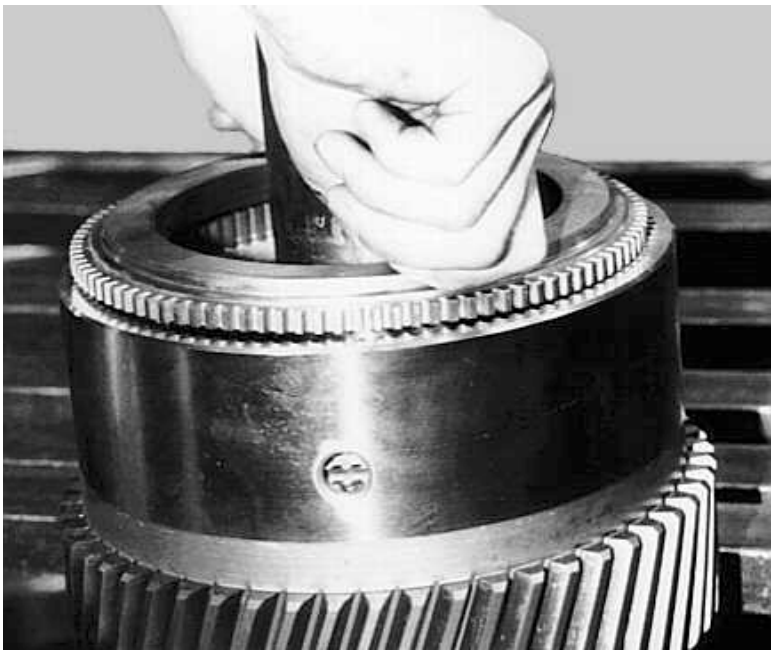


Figure 79. Installing Clutch Backplate

11. Install tapered roller bearing cone onto secondary shaft. Install with large diameter of bearing seating against shoulder of shaft inside the transfer gear opening.

Note: This bearing is a slip fit and will not require special tools for installation.

12. Assembly of pinion.

    A. Use special tool T-18050-607 to install chilled tapered roller bearing cup into rear of pinion for secondary shaft. Bearing cup is installed with small I.D. of taper toward the front and seated against shoulder of bore in clutch hub.

Figure 80. Installing Pinion Rear Bearing Cup

B. Install chilled needle roller bearing into bore at front of pinion.

C. Install internal retaining ring into groove in pinion bore.

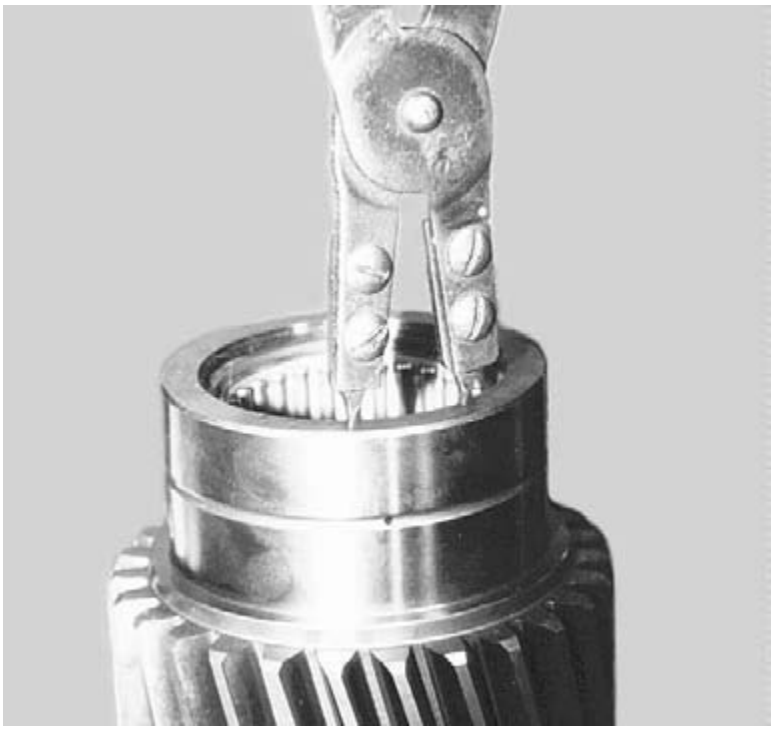


Figure 81. Installing Internal Retaining Ring Into Pinion

D. Align plates in clutch pack and install pinion on secondary shaft so that external teeth on clutch hub mesh with internal teeth of steel plates in clutch pack. Assure that clutch hub is in mesh with all clutch plates.

E. Install external retaining ring to retain pinion on shaft.

Figure 82. Installing External Retaining Ring Onto Clutch Shaft

13. Install two piston rings into grooves at rear end of shaft.

14. Assemble primary shaft. Assembly procedure for primary shaft is exactly the same as for the secondary shaft. Repeat above procedure in steps 1 through 13.

15. Install clutch shaft assemblies into transmission housing. Use caution to prevent damaging the shafts, gears, and bearings.

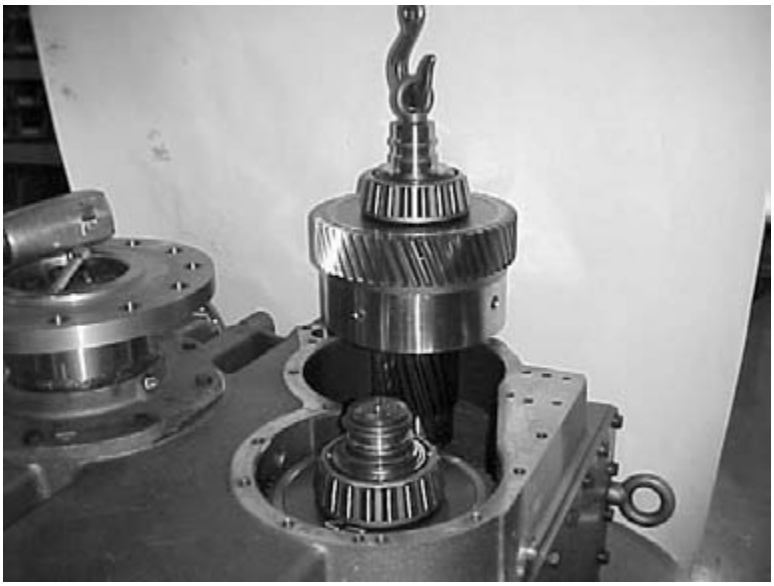


Figure 83. Installing Clutch Shaft Assembly

Installation of Bearing Carrier

1. Install bearing carrier gasket over dowels onto rear face of housing. Install with silicone beaded side up.

2. Assemble lube relief valve spring and lube relief valve steel ball into lube relief valve housing. Attach assembled lube relief valve to inner face of bearing carrier with the screws and washers. Torque the screws to 33 Nm (24 ft-lb).

3. Install two alignment studs into face of transmission housing. Install bearing carrier over studs and onto dowels in housing face. Use a soft hammer (near the dowels) to seat carrier against gasket and over dowels.

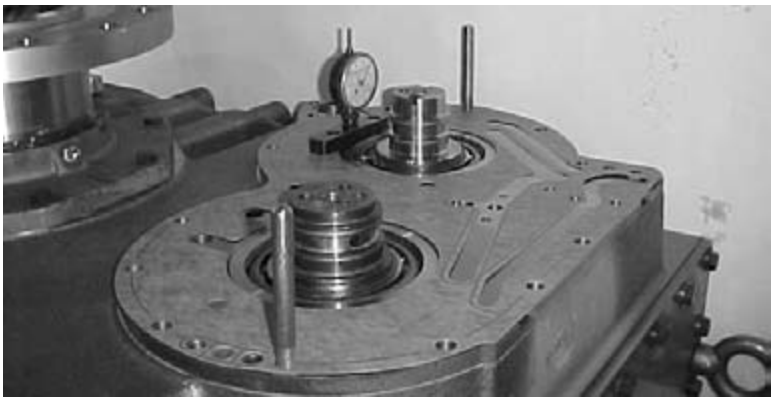


Figure 84. Bearing Carrier Installed

4. Install lube tube through “keyed” hole in bearing carrier and into machined pocket in front inner face of housing. Rotate tube so elongated “key” of tube fits into corresponding “key” in bearing carrier. Properly installed lube tube will be flush with rear face of bearing carrier.

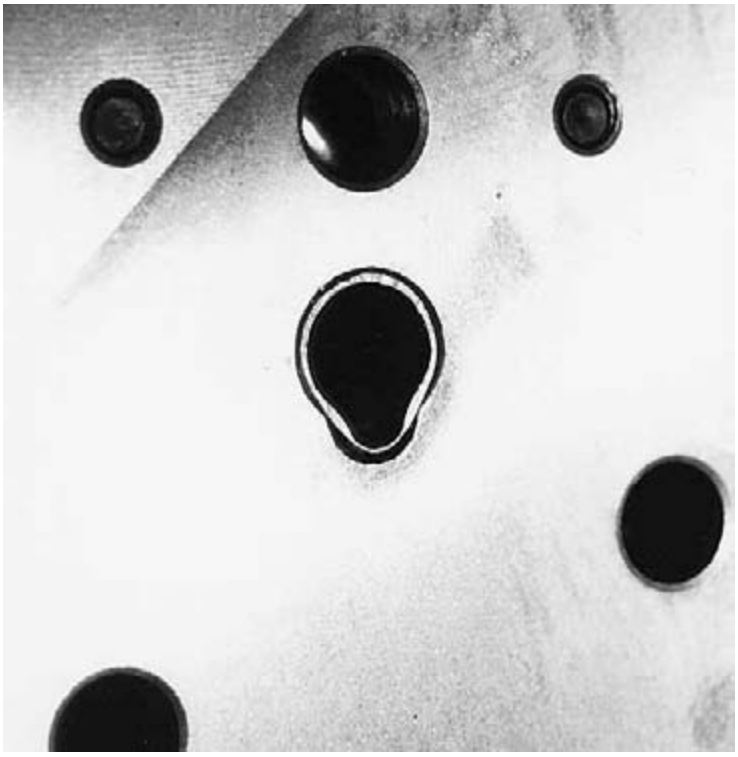


Figure 85. Key Orientation of Installed Lube Tube

5. Install cups for rear tapered roller bearings on primary and secondary shafts into bores in bearing carrier. Tap cups down gently with soft hammer or brass drift to seat against bearing cones on shafts.

6. Install manifold gasket over alignment studs and against bearing carrier. Install with silicone beaded side up.

7. Push tapered roller bearing cups, with shim retainers, firmly against roller bearing cones on rear of primary and secondary shafts. Use a depth micrometer to measure from manifold gasket face to shim retainers. Measured distance is shaft endplay. Use necessary shims to develop a shim pack for each shaft to reduce shaft endplay to 0.05 mm to 0.15 mm (0.002 in. to 0.006 in.).

8. Install calculated shim pack at each shaft location with the thickest shim against bearing cup, followed by the remaining shims, and finally the retainer against shims at each shaft.

Assembly and Installation of Manifold

1. Install new O-rings onto the M18 O-ring plugs used for the clutch and lube pressure test ports. Lubricate the O-ring and threads and install the plugs, torquing them to 74 Nm (55 ft-lb). Place new O-rings onto the M22 O-ring plugs and install them into the manifold side opposite the oil filter boss, torquing them to 100 Nm (74 ft-lb). Place a new O-ring onto the M10 O-ring plug and install it into the manifold below the oil filter, torquing it to 25 Nm (18 ft-lb). Place a new O-ring onto the M27 O-ring plug and install it into the manifold above the oil filter, torquing it to 81 Nm (63 ft-lb).

2. Assemble and install filter bypass valve. Assemble parts in manifold oil inlet port in the following order:

   A. Check ball

   B. Spring

   C. Plug

3. Apply a coat of assembly grease or oil to the seal rings of both clutch shafts. Center the seal rings in the shaft grooves to prevent seal ring damage during manifold installation.

4. Install assembled manifold over alignment studs and dowels. Use a soft hammer (near the dowels) to seat manifold against gasket and over dowels. Install manifold attaching screws and torque to 112 Nm (83 ft-lb).

Primary and Secondary Shaft Bearing Adjustment

Note: Procedure for setting and checking endplay for primary and secondary shafts is the same. Procedure described and illustrated is for the secondary shaft. Repeat same procedure for the primary shaft.

1. With a felt-tip pen, make a mark across the rear end of the secondary shaft.

2. Install a dial indicator on a machined surface on the manifold with the probe resting on the mark made on the secondary shaft.

Figure 86. Checking Secondary Shaft Bearing Adjustment

3. Install an eyebolt into the end of the shaft and exert 890 N (200 lbs) downward force while rotating the shaft several revolutions in each direction. Stop so that the dial indicator probe is resting on the mark.

4. Zero the dial indicator.

5. Remove downward pressure and exert 1334 N to 1557 N (300 lbs to 350 lbs) lifting force on the shaft. Rotate the shaft several revolutions in each direction stopping with the dial indicator probe resting on the mark.

6. Dial indicator reading is secondary shaft endplay. Endplay should be between 0.05 mm to 0.15 mm (0.002 in. to 0.006 in.). Add or remove shims as necessary to achieve correct endplay. Use dial indicator and above procedure to confirm that desired endplay has been attained.

7. Check endplay for primary shaft. Repeat steps 1 through 6 on the previous page to adjust endplay for primary shaft.

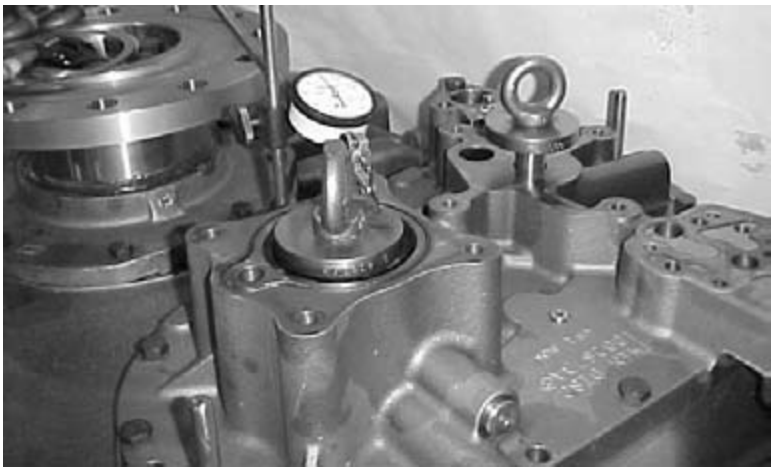


Figure 87. Checking Primary Shaft Bearing Adjustment

Installation of Manifold Exterior Components

1. Install pump suction strainer into bore in manifold.

2. Install O-ring into groove in suction screen cover. Apply assembly grease or oil to the O-ring.

3. Install suction screen cover and secure with clamp plate and screw. Torque attaching screw to 112 Nm (83 ft-lb).

4. Install O-ring into groove in face of manifold at primary shaft location. Install cover onto manifold at primary shaft bore. Install attaching screws and torque to 112 Nm (83 ft-lb).

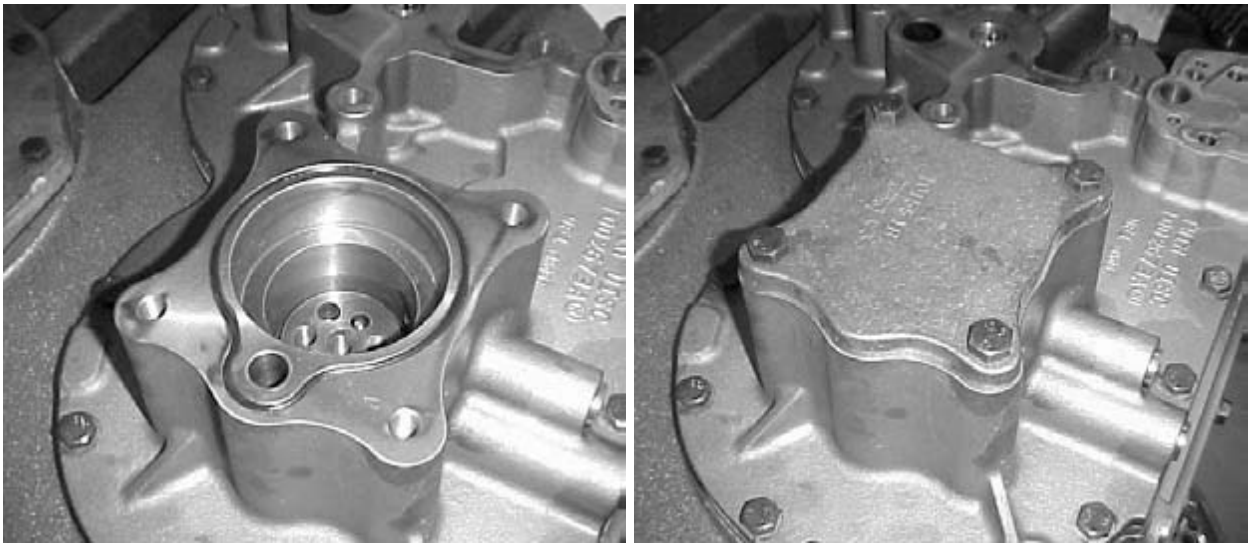


Figure 88. Primary Shaft Cover O-ring Installed (left) and Primary Shaft Cover Installed (right)

5. Install oil pump gasket and oil pump at mounting location at end of secondary shaft. Mesh drive tang on pump shaft with drive slot in secondary shaft. Install attaching screws and torque to 112 Nm (83 ft-lb).

6. Install oil filter.

Installation of Output Flange

1. Heat output flange in 300° F (150° C) maximum oven for a half hour to an hour.

2. Install heated output flange. Assure that flange seats solidly against rear tapered roller bearing on output shaft.

3. With a depth micrometer, measure distance from rear face of output flange to end of output shaft. Record this distance as dimension “A”. Measure distance from rear face of output flange to inner shoulder of flange against which retainer washer is installed. Record this distance as dimension “B”. Determine gap between retainer washer and end of shaft by subtracting dimension “B” from dimension “A”.

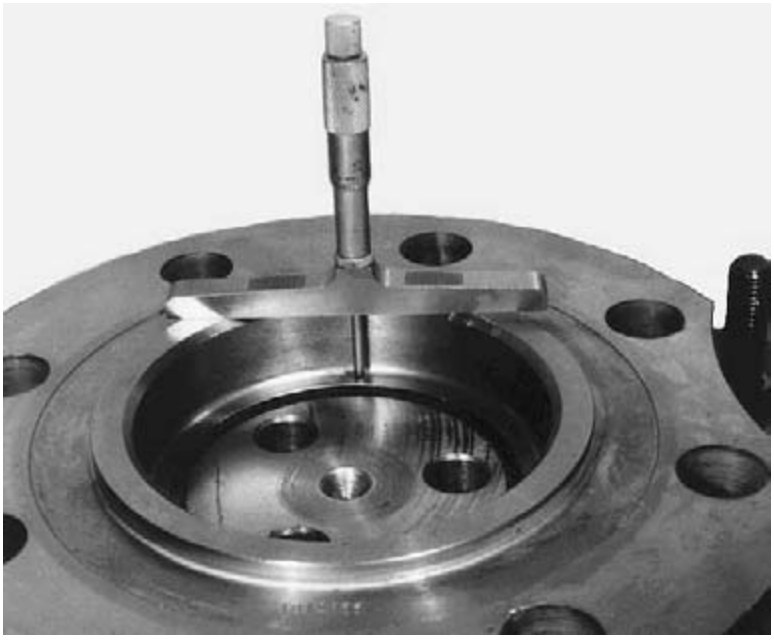


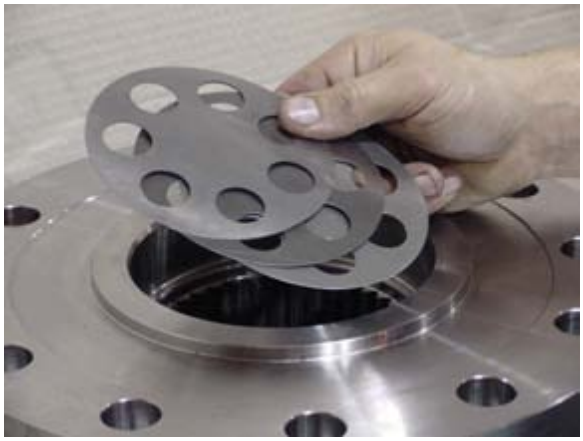
Figure 89. Measuring Output Flange Gap

Use shims to develop a shim pack to reduce gap between retainer washer and end of shaft to 0.076 mm to 0.152 mm (0.003 in. to 0.006 in.).

4. Install O-ring to seal output shaft splines and output flange.

Figure 90. Measuring Output Flange Gap

5. Install shim pack (developed in step 3) and retainer washer. Install the seven retainer washer sockethead capscrews and torque to 530 Nm (391 ft-lb).



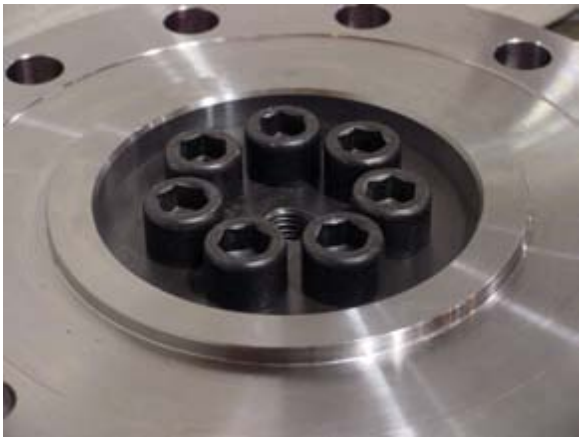


Figure 91. Output Flange Shims (left) and Screws Installed (right)

6. Attach dial indicator to housing with probe resting on face of output flange. Locate indicator probe as close to O.D. of flange as possible. Check flange face runout by rotating flange. Total indicated runout must not exceed 0.10 mm (0.004 in.).

7. Attach dial indicator to housing with probe resting on O.D. of output flange pilot. Check pilot runout by rotating output flange. Total indicated runout must not exceed 0.10 mm (0.004 in.).

Note: Should total dial indicator runout exceed 0.10 mm (0.004 in.) proceed as follows:

A. With a felt-tip pen, draw a line across the end of the output shaft and face of output shaft counterbore to mark original installed position of the output flange versus the output shaft.

B. Remove the output flange as described in Section 6 and reinstall 90° from original position. Recheck runout of flange face and flange pilot using procedures in steps 6 and 7 above. If runout is within specification, do nothing more.

C. If runout continues to exceed tolerance, repeat procedure in (B) above at positions 180° and 270° from originally installed output flange position. Stop at whatever position output flange runout is no more than 0.10 mm (0.004 in.).

D. If output flange runout cannot be reduced to acceptable tolerances, contact the Product Service Department at Twin Disc, Incorporated for information/recommendations.

Assemble Control Valve

Assembly of Mechanical Control Valve

1. Install the thrust race, thrust bearing, and remaining thrust race onto the stem.

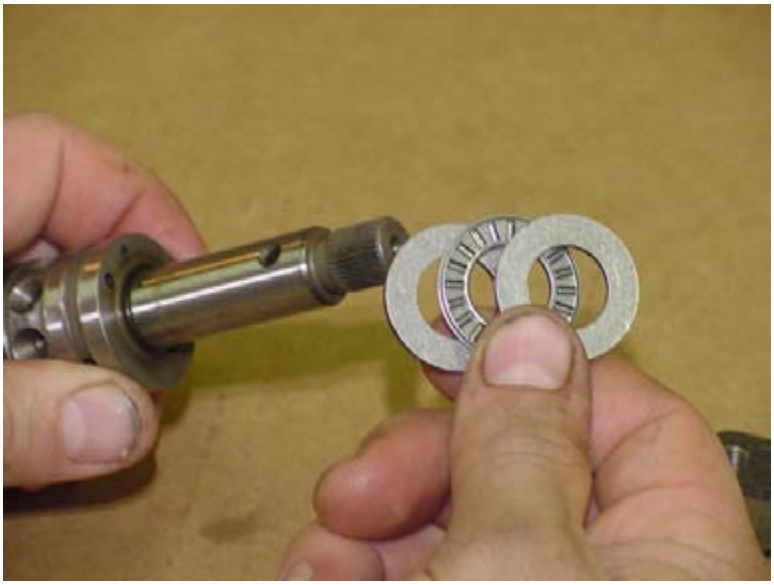


Figure 92. Installing Thrust Bearing and Races

2. Install a new oil seal and O-ring into the valve cover.

3. Apply assembly grease or oil to the shaft of the valve stem, the oil seal, and the O-ring. Install the stem into the valve cover.

4. Install the stop collar onto the stem so that the roll pin holes are aligned as well as the marks made at disassembly. Drive the roll pin into the collar and stem while supporting the stem to prevent damage to the parts.

Figure 93. Installing Stop Collar (left) and Roll Pin (right)

4. Place the cover gasket over the stem assembly against the cover. Install the assembly into the valve body, and torque the attaching screws to 33 Nm (24 ft-lb).

Figure 94. Installing Stem Assembly into Valve Body

5. Install the detent ball, spring and O-ring plug. Torque the plug to 37 Nm (27 ft-lb).

Figure 95. Installing Detent Ball, Spring, and O-ring Plug

6. Install the valve lever, aligning the marks made at disassembly. Torque the screw to 15 Nm (11 ft-lb).

7. Install the pressure regulator piston and springs into the valve body.

Figure 96. Installing Regulator Piston (left) and Springs (right)

8. Install the pressure regulator adjustment shims into the rate-of-rise piston.

Figure 97. Pressure Regulator Adjustment Shims

9. Install the rate-of-rise piston (with shims) into the valve body.

10. Install the check ball spring shim(s) and spring into the valve body.

Figure 98. Installing Check Ball Spring Shim(s) and Spring

11. Place one orifice plate gasket, the check ball, and the orifice plate onto the valve body.

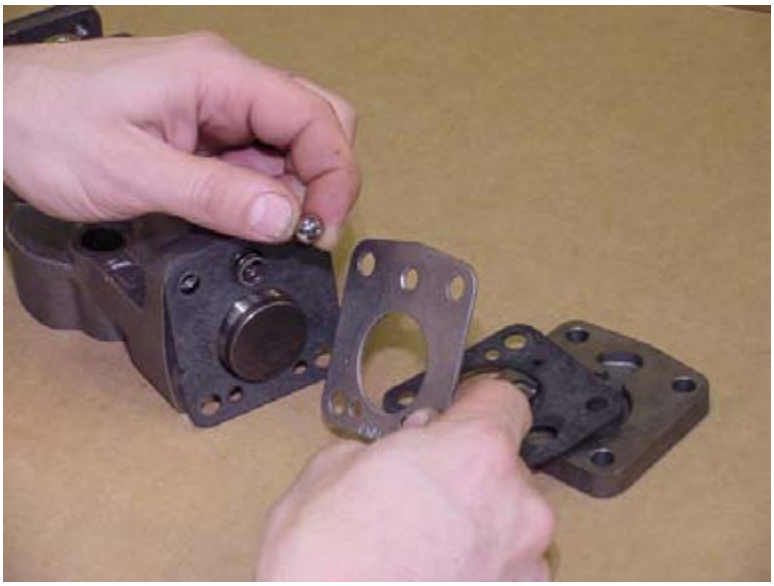


Figure 99. Installing Gasket, Check Ball, and Orifice Plate

12. Install the remaining gasket and orifice plate cover onto the valve body. Install the attaching screws and tighten them alternating and evenly to 33 Nm (24 ft-lb).

13. Install valve onto the transmission and torque the attaching screws to 52 Nm (50 ft-lb).

14. Install the remaining O-ring plugs. Torque the M12 plugs to 37 Nm (27 ft-lb), and the M27 O-ring plug to 171Nm (131 ft-lb).

Assembly of Electrical Control Valve (upperbody half)

1. Install one dowel pin (large diameter) into each of the two bores of the valve body.

2. Install one spring into each of the two bores of the valve body.

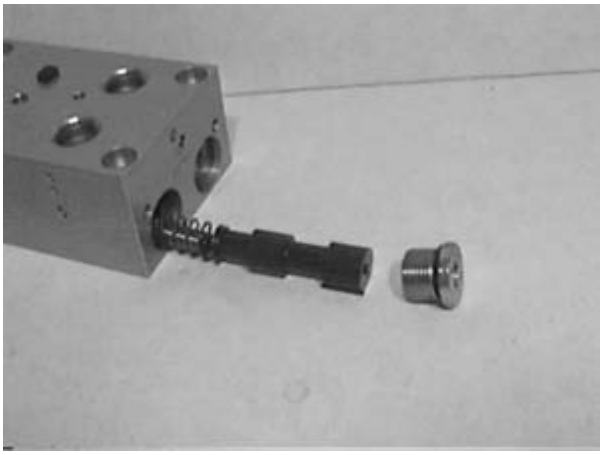


Figure 100. Dowel, Return Spring, Spool, and Plug

3. Install one spool into each of the two bores of the valve body.

4. On units equipped with the hydraulic lock feature, install one spring followed by one pin (small diameter) into each of the spools.

5. Install the two O-ring plugs into the valve body and tighten to 85 Nm (63 lb-ft.)

6. Apply lubricant (such as Dow Corning 200® 30,000cSt fluid) to the O-rings of the solenoids and plug (plug used on units without hydraulic lock). Install solenoids (and plug, if equipped) into the valve body and torque them to 34 Nm (25 lb-ft.).

7. Insert the wires (pins) into the Weatherpak connector according to the location markings made at disassembly. Close the end of the Weatherpak connector to lock the wires in position.

8. Install the Weatherpak connector onto its retaining clip on the top of the valve body.

Assembly of Electrical Control Valve (lower body half)

1. Install the steel shuttle ball into its bore in the valve body.

2. Install the O-ring onto the shuttle ball seat.

3. Apply lubricant such as Dow Corning 200® 30,000cSt fluid to the O-ring, and install the seat into the valve body. Be sure to align the roll pin holes in the seat with the holes in the valve body. One of the valve's M8x1.25 cover screws threaded into the seat can be used to adjust the seat location in the valve body.

4. Install the roll pin to retain the shuttle ball seat. Drive the roll pin in until it is flush with the gasket surface of the valve body.

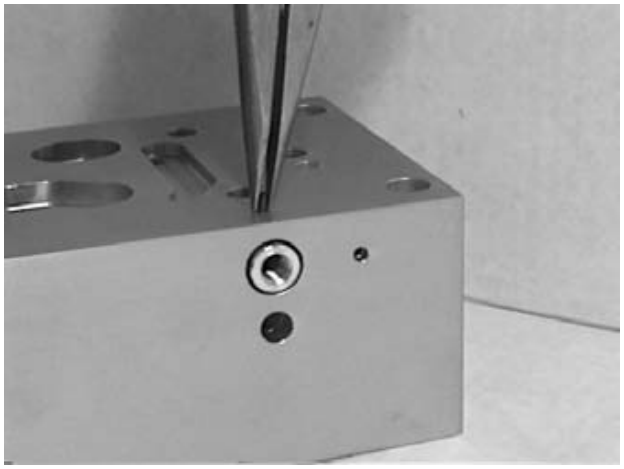


Figure 101. Installing Shuttle Ball Seat Roll Pin

5. Install the stem into the valve body, aligning the slot in the stem with the threaded hole in the valve body for the dog-point setscrew. Be sure the slot in the stem is aligned with the setscrew hole in the valve body to prevent damage to the stem and valve body.

6. Apply MA908 threadlocker to the threads of the dog-point setscrew and install. Tighten the dog-point setscrew until snug, then back off 1/2 turn.

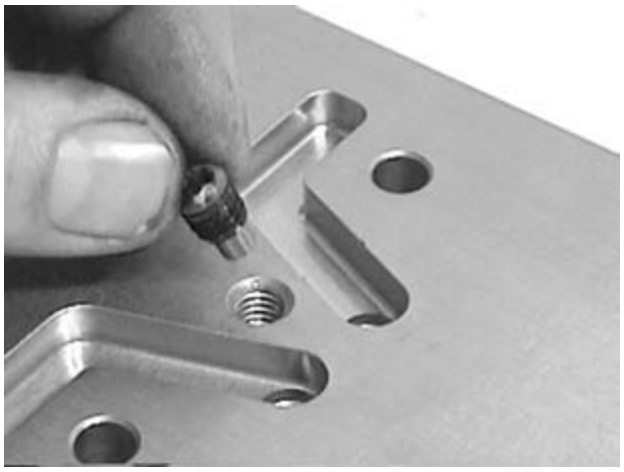


Figure 102. Installing Dogpoint Setscrew

7. Install the steel detent ball into the valve body.

8. Install the detent spring over the detent ball.

9. Apply MA908 threadlocker to the threads of the hollow setscrew and install into the threaded hole. A stepped Allen wrench, or one wrapped with tape will ease the installation of the hollow setscrew. Tighten the setscrew until it is flush with the gasket surface of the valve body. Check the stem rotation and detent action.

Figure 103. Installing Detent Ball Setscrew

10. Install the thrust washer over the end of the stem.

11. Press the oil seal into the cover assembly until flush with the adjacent cover surface.

12. Install the O-ring into the counterbore in the cover assembly.

13. Apply grease to the stem, O-ring, and oil seal lip.

14. Install cover assembly and gasket onto valve body. Be sure to align the oil drain hole in the gasket with the hole in the valve body.

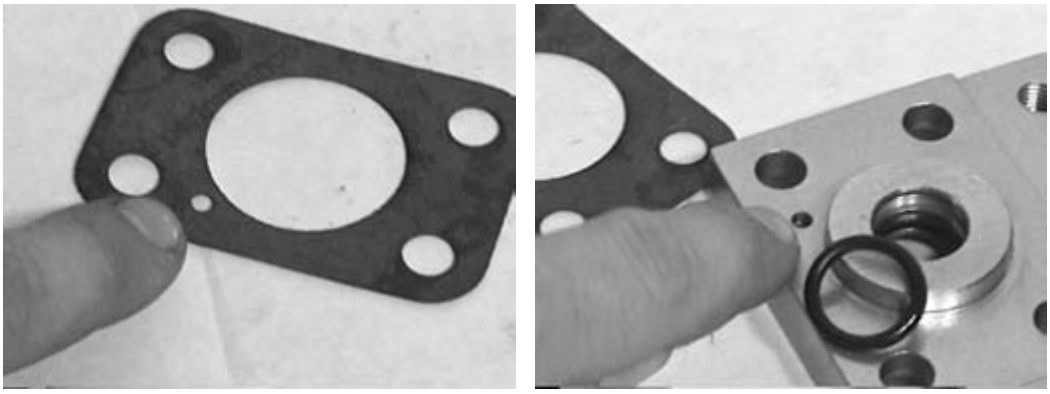


Figure 104. Holes in Gasket and Cover Must be Aligned

15. Install cover capscrews and torque to 23 Nm (17 lb-ft).

16. Install washer over stem and against oil seal.

17. Install spring over stem against washer.

18. Install lever onto the stem. It may be necessary to splay the lever to be able to install it. DO NOT apply any impact force to the lever, as the stem or dog-point setscrew may be damaged. Torque the lever's attaching screw to 9.5 Nm (7 lb-ft).

19. Install external retaining ring onto stem .

20. Install the steel balls and electrical switches into the bores in the sides of the valve body (if equipped). Note that the small diameter ball is inboard of the large diameter ball at each switch location.

21. Install the pressure regulating piston into valve body with spring pocket out.

22. Install pressure regulating springs into valve body and into piston spring pocket.

23. Install the shims that were removed into the bore of the rate-of-rise piston. Install the rate-of-rise piston over the springs and into valve body.

24. Install neutral pressure regulating spring into the pocket of valve body.

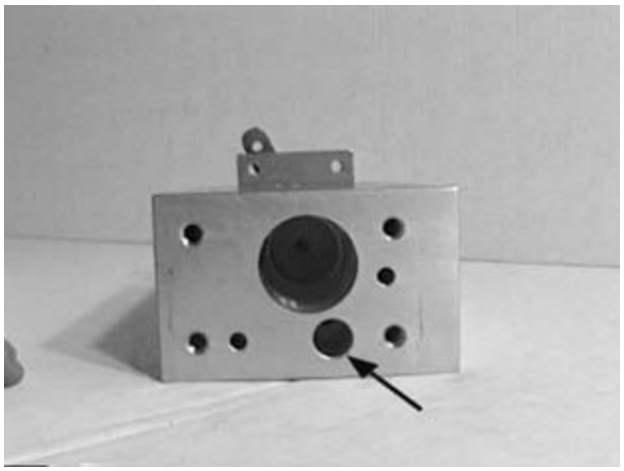


Figure 105. Neutral Pressure Regulating Spring Location

25. Install orifice plate gasket onto valve body.

26. Install orifice plate and steel ball (against spring) onto valve body.

27. Install orifice plate cover and gasket onto valve body. Install cover capscrews and torque to 23 Nm (17 lb-ft).

28. Install gasket over lower valve body half.

29. Set upper valve body half over lower valve body half. Insert the valve attaching screws through valve body halves to keep parts in alignment until installation onto the transmission. When installing the valve onto the transmission, torque the screws to 54 Nm (40 lb-ft.).

Assembly of Trolling Valve (Optional Equipment)

1. Press a new oil seal into the counterbore in the end of the adapter. Install a new O-ring into the groove of the adapter.

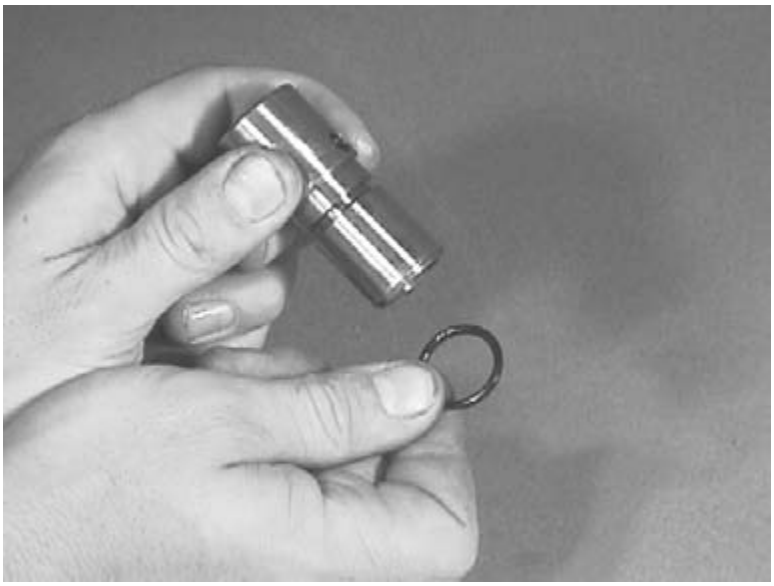


Figure 106. Installing O-ring onto Adapter

2. Install a new O-ring into the groove of the stem.

3. Install the roll pin into the end of the stem (if removed).

4. Install the inner spring onto the roll pin in the stem end with a counterclockwise twisting motion. The spring is to be installed onto the roll pin such that the first coil contacts the end of the stem.

5. Apply assembly grease to the stem, from the O-ring to the reduced diameter end. Install the stem into the adapter, with the reduced diameter end entering the adapter first. Adjust the position of the stem if necessary to bring the helical slot into alignment with the dog-point setscrew hole.

6. Install the large diameter washer (used on some models) inside the bore of the adapter and over the inner spring until it lays flat on the end of the stem.

7. Install the small washer (used on some models) inside the piston. The washer must lie flat at the bottom of the bore in the piston.

8. Apply assembly grease to the adapter (where it contacts the trolling valve body) and install the adapter into the valve body. Be sure to align the setscrew holes in the adapter with those in the valve body.

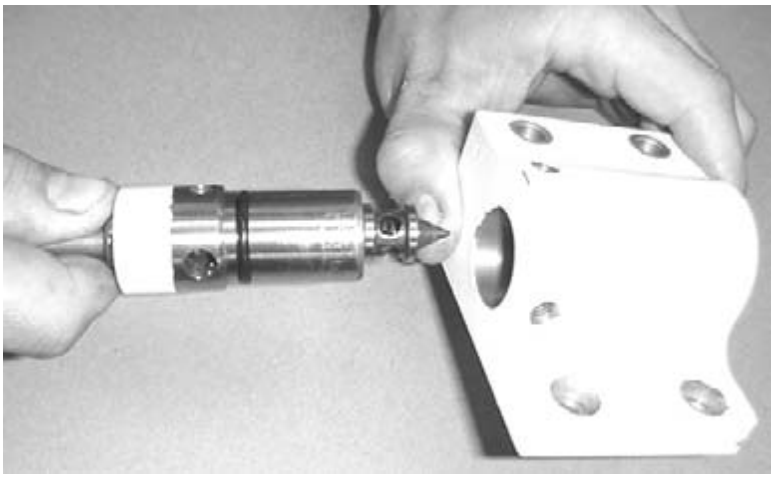


Figure 107. Installing Trolling Valve Parts Into Trolling Valve Body

9. Apply MA908 threadlocker to the threads of the dog-point setscrew and install. Tighten the dog-point setscrew until snug, then back off 1/2 turn. The end of the setscrew should protrude approximately 3mm from the valve body when the dog point of the setscrew is fully engaged in the helical slot.

Figure 108. Installing Dog-point Setscrew

10. Check the action of the stem in the trolling valve. If the stem does not rotate 90° smoothly, loosen the dog-point setscrew 1/8 turn and recheck the action of the stem.

11. Install the detent ball and spring into the remaining hole in the valve body. Apply MA908 threadlocker to the threads of the detent setscrew and install until flush with the valve body.

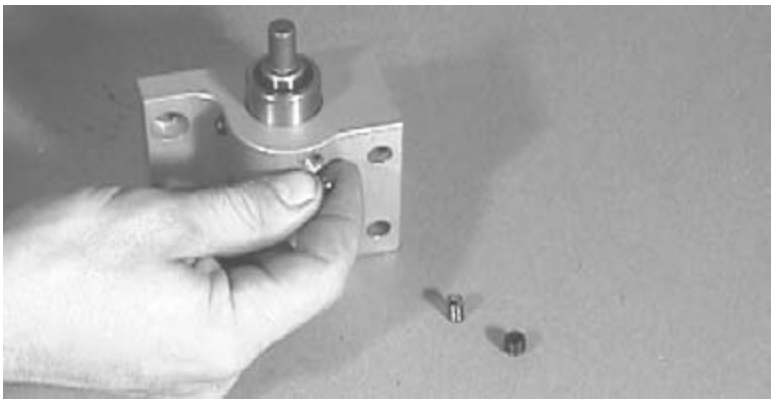


Figure 109. Installing Detent Ball, Spring, and Setscrew

12. Check the torque required to overcome the detent. The torque should be 1.1-1.7 Nm (10-15 in-lb). Adjust the detent setscrew if necessary to achieve the proper torque to rotate the lever out of the detent position.

13. Install the lever onto the stem. It may be necessary to splay the lever to be able to install it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

14. Rotate the lever (if necessary) on the stem to the position shown on the valve installation drawing (see Engineering Drawing Section of this manual). Install the screw and nut to clamp the lever to the stem. Tighten the screw and nut to 9.5 Nm (7 ft-lb).

15. Install the neutral pressure regulating spring into the bore of the control valve (if removed).

16. Install the steel ball onto the neutral pressure regulating spring.

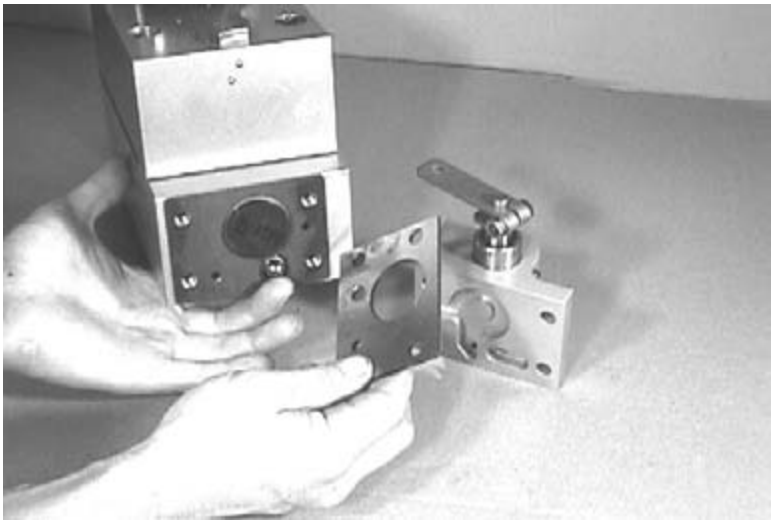


Figure 110. Installing Neutral Pressure Regulating Spring and Ball

17. Install the orifice plate gasket, orifice plate, trolling valve gasket, and trolling valve onto the control valve. Install the attaching screws and torque them to 23 Nm (17ft-lb).

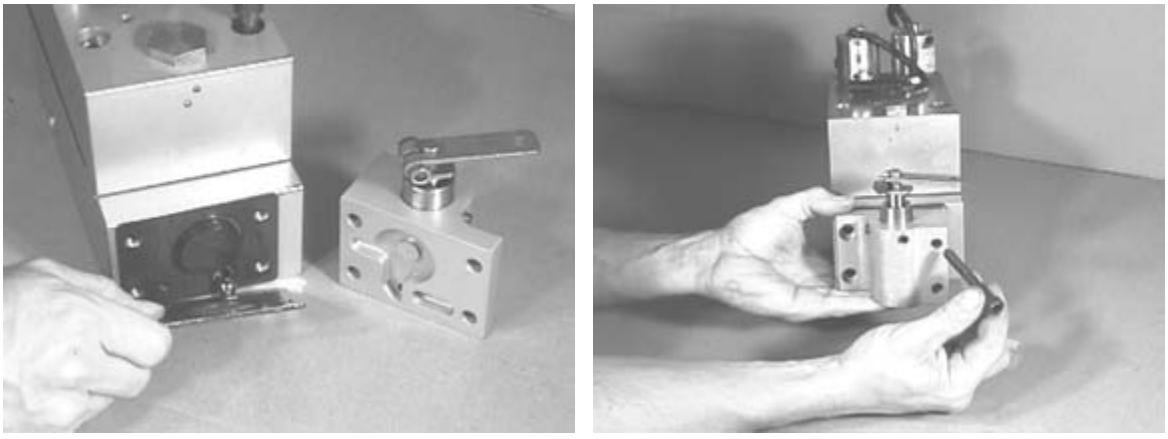


Figure 111. Installing Orifice Plate (left) and Trolling Valve Onto Valve Body (right)

Installation of Transmission External Components

1. Install control valve ditch plate and gasket (units with optional electric control valve). Torque the ditchplate attaching capscrews to 75 Nm (55 ft-lb).

2. Install control valve and gasket. Torque the valve attaching capscrews to 54 Nm (40 ft-lb).

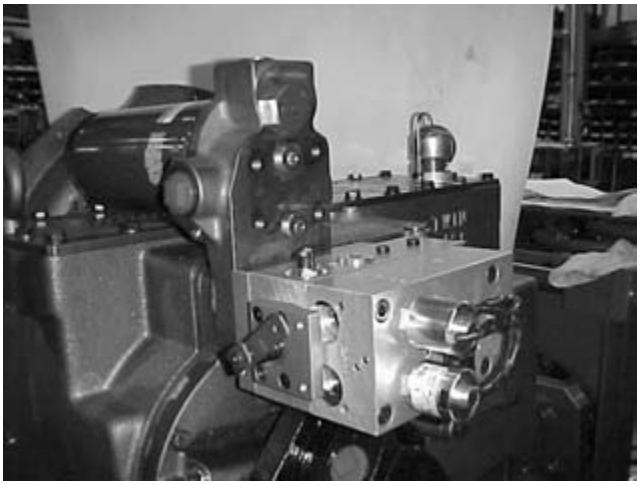


Figure 112. Optional Electric Control Valve Installed

3. Turn transmission over, supporting it by the output side (input side up).

4. Coat input seal bore of housing and outside diameter of input seal with a thin film of M2828 anaerobic sealant (do not apply excessive sealant, as seal and/or bearings may be damaged). Verify that there is no M2828 sealant on primary shaft. Apply a film of oil or assembly grease to the seal surface of the primary shaft. Install input shaft oil seal into housing using seal protector T-21347 and driver T-21347-1. Press oil seal into bore with the spring-loaded lip of seal toward the inside of the housing. Press seal into bore until outer face is flush with bottom of counterbore in housing.

5. Install front housing onto transmission housing. Install attaching screws and torque to 112 Nm (83 ft-lb).

6. Attach a dial indicator to the input shaft spline using fixture T-21302-1 with the probe on the front housing machined face. Rotate input shaft and note total indicator runout. The runout must not exceed 0.42 mm (0.016 in) for both a SAE #0 and SAE #1 housing.

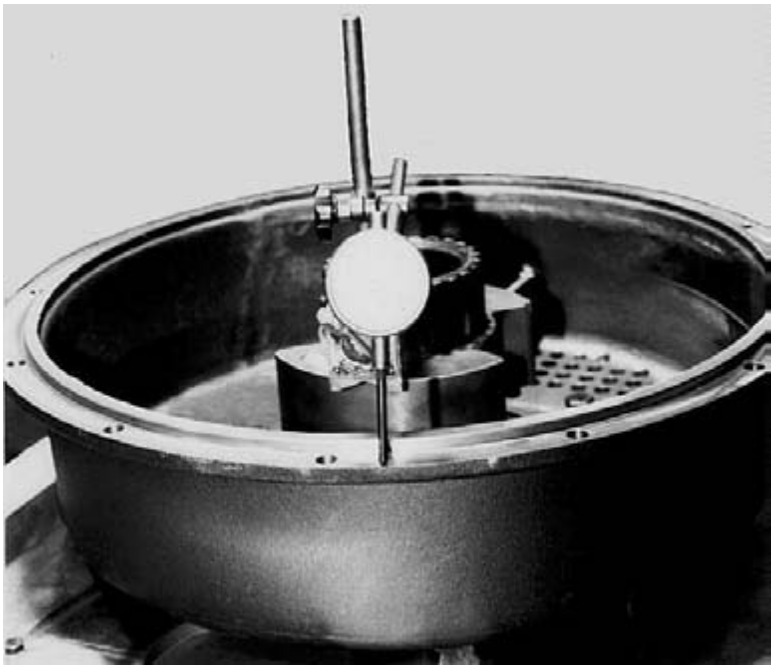


Figure 113. Measuring Front Housing Face Runout

7. Attach a dial indicator to the input shaft spline using fixture T-21302-1 with the probe on the O.D. of the front housing pilot. Rotate input shaft and note total indicator runout. The runout must not exceed 0.30 mm (0.012 in) for both a SAE #0 and SAE #1 housing.

   Note: Should total indicator runout exceed stated limits, contact the Product Service Department of Twin Disc, Incorporated for information and recommendations.

8. Slide input coupling onto splines of input shaft. If the unit is to be shipped with the coupling on the shaft, it must be attached to prevent it from sliding off and causing damage.

Installation

Prior to Installation

⚠ CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine, or are attached to the flywheel through external shafting or adapters. Flywheel-to-driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, the crankshaft endplay should be measured again. The endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin Disc will not be responsible for system damage caused by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

The transmission housing flange and pilot, the engine flywheel and the flywheel housing must be checked for trueness. Clean the engine flywheel and flywheel housing mounting surfaces thoroughly before any measurements are made.

Note: To isolate engine vibration and prevent transferring it to the hull through the propeller shaft, the distance from the marine gear output flange to a fixed stuffing box or the first fixed bearing must be a minimum of 20 times the shaft diameter. If the distance is less than this, a flexible coupling may be necessary to isolate the engine vibration.

Alignment (also reference SAE J-1033 and J-617)

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange.

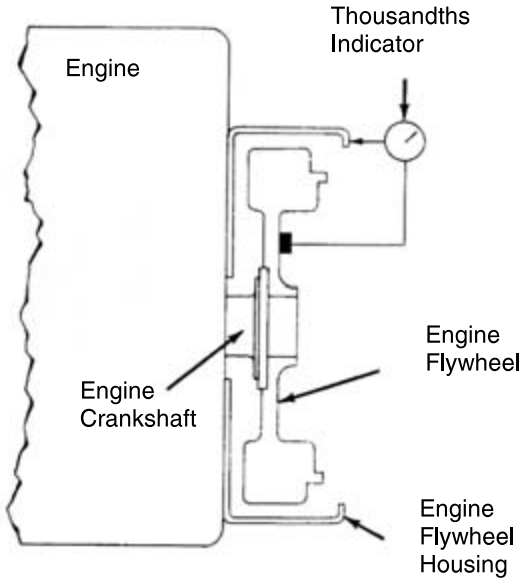


Figure 114. Checking Flywheel Housing Flange for Deviations

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel-housing flange. The face deviation must not exceed the figures given in Table 9.

Table 9. Total Indicator Readings for Engine Flywheel Housing Flange

SAE Housing Number	Face Deviations and Bore Eccentricity mm (in)
00	0.48 (0.019)
0	0.41 (0.016)
1/2	0.36 (0.014)
1	0.30 (0.012)
2	0.28 (0.011)
3	0.25 (0.010)
4	0.23 (0.009)
5	0.20 (0.008)
6	0.18 (0.007)

3. With the indicator mounted as in the above paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing.

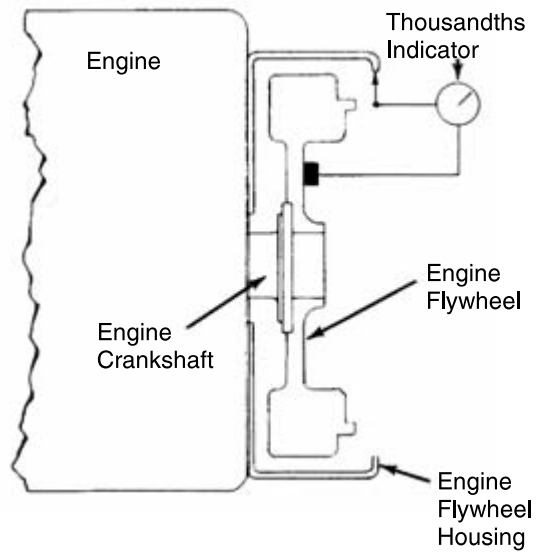


Figure 115. Checking Flywheel Housing Bore Eccentricity

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel-housing bore. See the above Table for allowable tolerances.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator tip is riding on the inner face of the flywheel. Rotate the flywheel. The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.013 mm (0.0005 in) per inch of diameter.

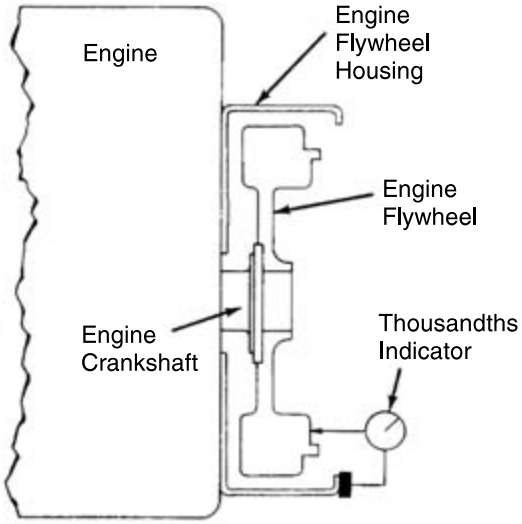


Figure 116. Checking the Flywheel Face Runout

6. With the indicator mounted as in the paragraph above, adjust the indicator tip so that it will ride on the driving ring pilot bore of the engine flywheel. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.13 mm (0.005 in) maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

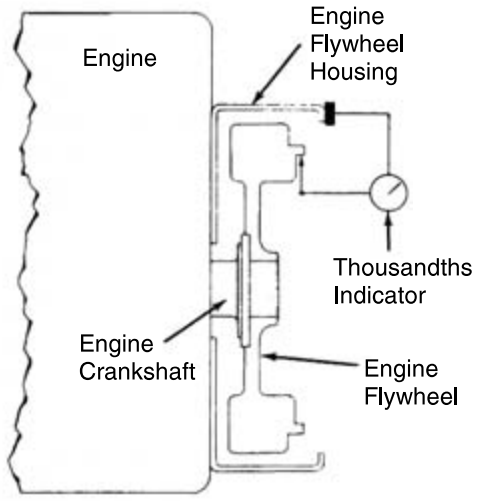


Figure 117. Checking the Flywheel Pilot Ring Bore Eccentricity

Installation

Alignment

Proper alignment of an engine and marine unit is critical, both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. Engine and shaft alignment can also change on a boat due to varying loads and the boat's age. The following steps may be taken to secure proper marine transmission alignment.

When reinstalling a marine gear after a repair, or when installing a new marine gear to an engine already mounted in the bed rails, the flywheel housing should be checked for deflection using the following procedure:

Install the mounting brackets on the side mounting pads of the marine gear. Install the driving ring on the engine flywheel. Bolt an indicator to the engine block and set the indicator stem on the engine flywheel housing

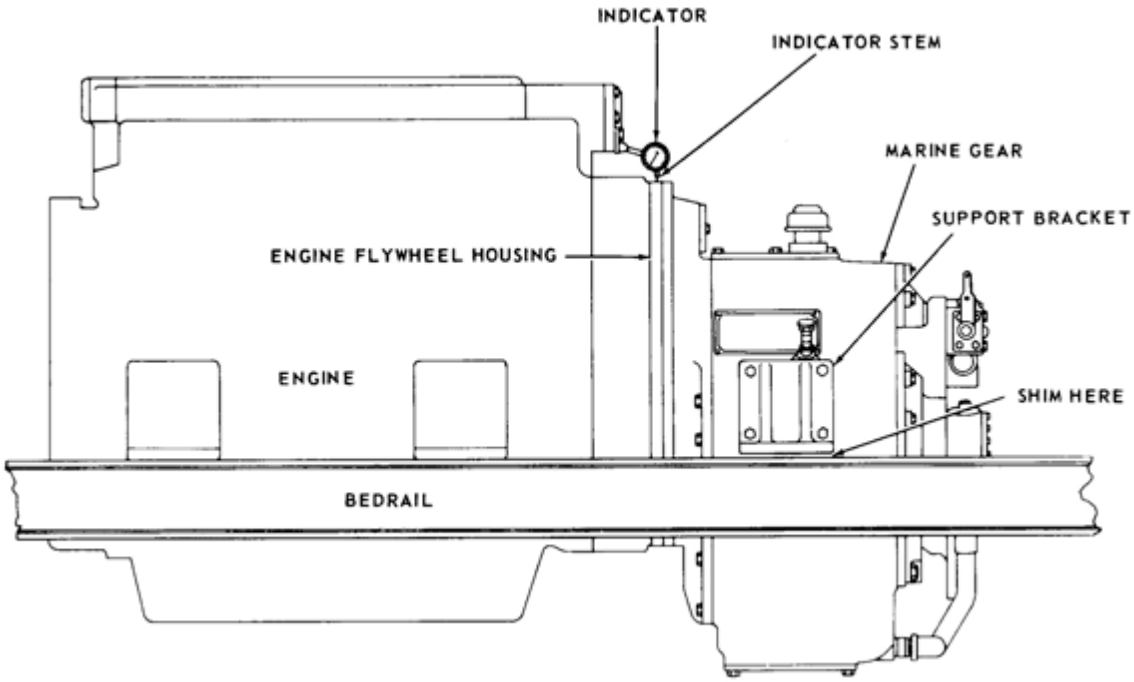


Figure 118. Marine Gear Alignment

Set the indicator gauge at zero (0). Lift the marine gear with a hoist, or other suitable means, and place the unit in position against the engine flywheel housing. Secure the flange of the marine gear main housing to the engine flywheel housing. Use a feeler gauge between each mounting bracket and engine bed rail. Add shims between the brackets and bed rails to equal the feeler gauge readings. Carefully release the lifting force on the marine gear while observing the indicator. The indicator gauge must remain steady at the zero mark. Torque the bed bolts to the proper rating. If the reading moves from zero, lift the marine gear and insert additional shims. Continue this procedure until the marine gear is completely at rest on the bed rails and the gauge maintains a steady zero reading. After obtaining the correct zero reading, indicating no distortion of the engine flywheel housing, secure the mounting brackets to the engine bed rails. Before securing the mounting brackets to the engine bed rails, the propeller shaft should be checked for alignment.

Note: The transmission output flange and companion flange bolts must be torqued to the proper value as identified in Description and Specifications.

Torsional Input Coupling Alignment - Free Standing Units

Alignment of freestanding transmissions must begin by aligning the transmission output flange to the propeller shaft. The engine must then be moved to properly align the engine flywheel to the transmission input hub.

Engine and Marine Transmission Alignment

⚠ CAUTION

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and transmission must be used. Failure to do so may result in damage to the transmission or the engine flywheel housing.

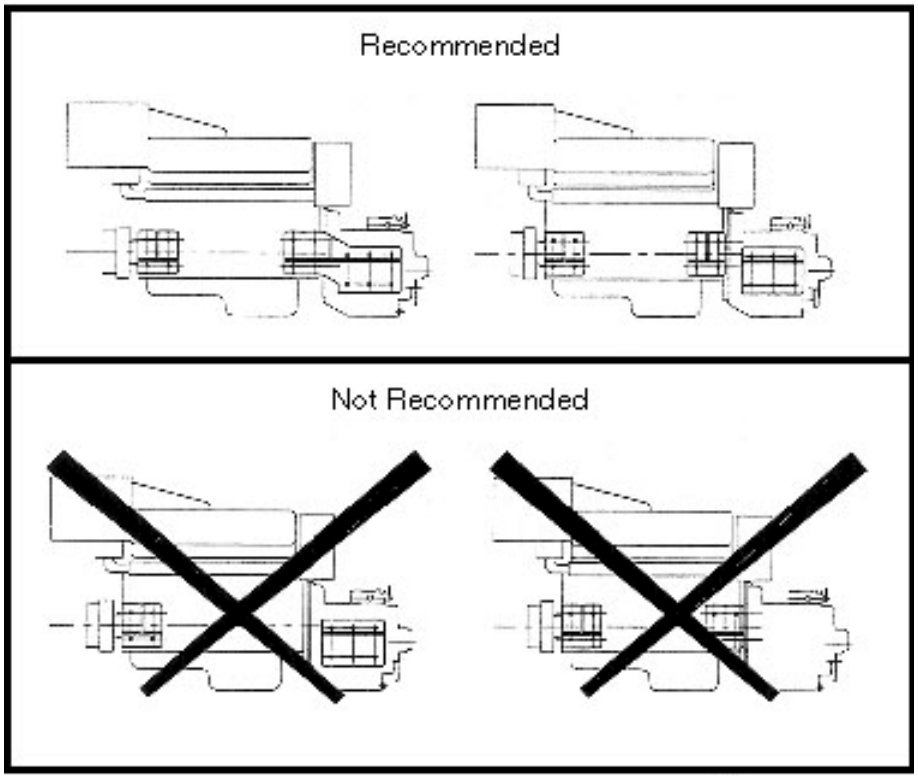


Figure 119. Transmission Mounting Configurations

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and the transmission must be used. Failure to do so may result in damage to the transmission.

It is important to align the engine and transmission only when the boat is afloat, and NOT in dry-dock. During this alignment period, it is also advisable to fill the fuel tanks and load the boat in the typical manner that it is to be used. Some boats are built with flexibility and may change shape as the loading varies.

When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission coupling to prevent bending of the shaft.

With the engine and transmission in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off on the jacking screws to obtain the desired adjustment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the engine and transmission to one side or the other on the engine bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

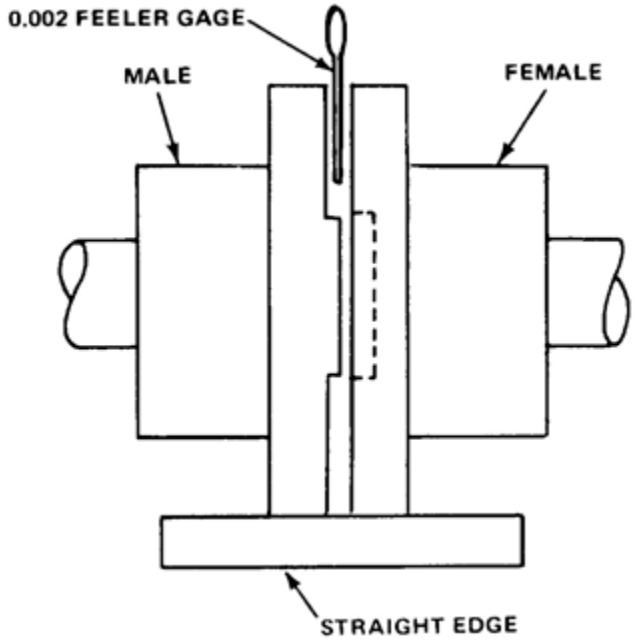


Figure 120. Checking Parallel Alignment of the Coupling

As the engine and marine transmission come into their aligned position, it will be possible to mate the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.05 mm (0.002 in) feeler gauge between the flanges of the coupling. Move (slide) the feeler gauge completely around the coupling. Rotate the marine transmission flange coupling in 90 degree increments, and move the feeler gauge around the flange in each successive position. The feeler gauge will fit snugly, with the same tension, all around the flange coupling in all four positions if the alignment is correct.

If the alignment varies during rotation, additional alignment is necessary, or the marine transmission and shaft couplings should be checked for proper face runout. Runout must not exceed 0.10 mm (0.004 in). Excessive face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline or taper. Excessive shaft coupling runout is usually due to inaccuracy of the taper fit or key to keyway interference. The optimum relative mating location will be where the measured runout dimensions of the transmission flange and the shaft coupling flange compliment each other to result in the least relative out of true parallel measurement.

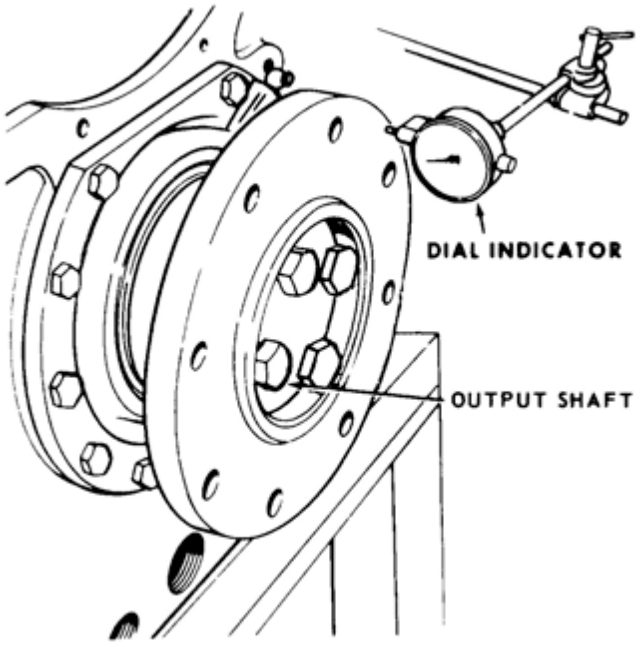


Figure 121. Checking Output Flange Face Runout

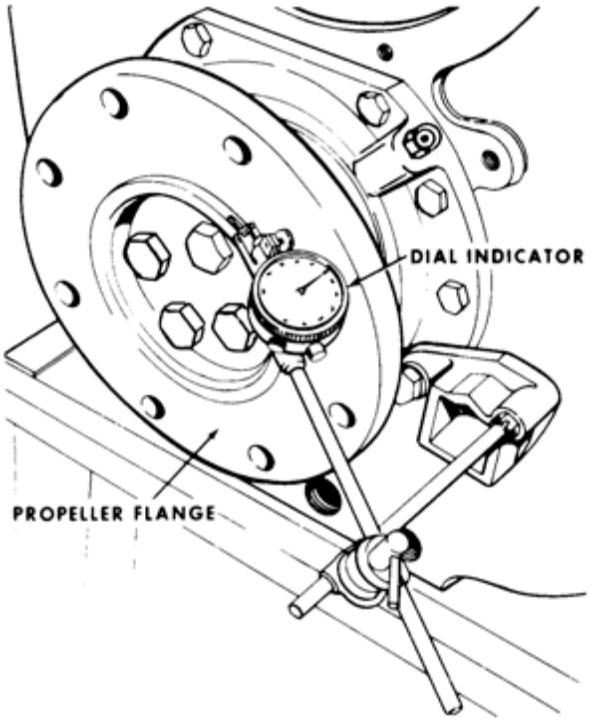


Figure 122. Checking Output Flange Pilot Eccentricity

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. Where this condition exists, it important to apply common sense alignment techniques to minimize the potential damage to any of the components.

During the process of securing final alignment, it may be necessary to shift the engine many times. When the final alignment is accomplished, mark and drill the holes for the lag studs or locating dowel pins. Then with final alignment secured, make up the necessary poured, steel, or hardwood shims, and fasten the engine and transmission in place. Then recheck the alignment, and if satisfactory, bolt the coupling together.

There are many types of flexible couplings in the market today that solve a variety of problems:

- ❑ Couplings to reduce noise and vibration.
- ❑ Couplings to allow a permanent angular misalignment.
- ❑ Couplings that allow engines to be flexibly mounted and take out the momentary misalignment.

In some cases, the proper alignment of these couplings requires an accuracy equal to that of rigid couplings. Always use the alignment procedures recommended by the coupling manufacturer.

Torsional Input Couplings Installation - For Models Provided by Twin Disc

⚠ CAUTION

Be sure the internal retaining ring is properly installed inside the torsional input coupling hub. See Engineering Drawings section of this manual for correct ring location.

Assembly Instructions for CENTAFLEX - R on Flange Mounted Gears. Information Taken Directly from CENTA Drawing 26-60062-91-3.

1. Bolt flywheel flange onto flywheel and tighten bolts as follows.

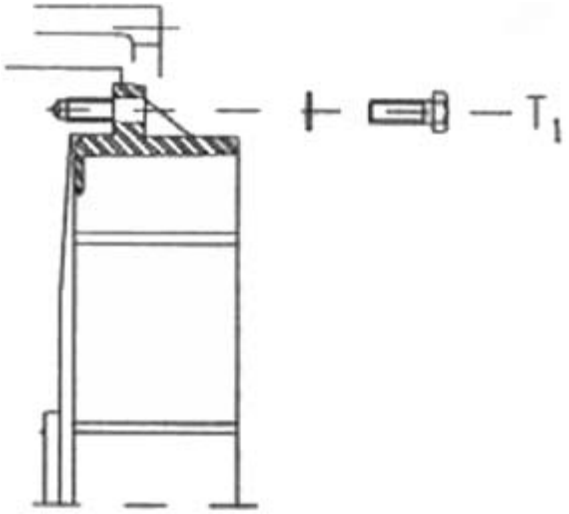


Figure 123. Assemble Flywheel Flange to Flywheel

Table 10. Centa Torque Chart

SAE	Bolt	Grade	Tightening Torque	
			(Nm)	(inch-lbs.)
11.5	M10	8.8	50	433
14	M12	8.8	85	738
18	M16	8.8	215	1868
21	M16	8.8	215	1868

Tightening torque is for slightly oiled bolts, tolerance is + or - 5%. Securing of the bolts by adhesives (e.g. Loctite) is possible.

Assembling of output hub: (This procedure is for gears with splined shaft, where the output hub of the coupling is axially free.)

2. Place rubber rollers in the deepest section of the cam in the output hub. Normally they stick there by friction.

Figure 124. Insert Rollers and Note Alignment

3. In case, that they should not stick, place a tape or a cord with a slipknot around all rollers close to the gear side. Let the end of the tape or cord long enough, that it is hanging outside the flange. Turn the two couplings halves in a position, that the arrows of both halves are just opposite See Figure 124 (View X).

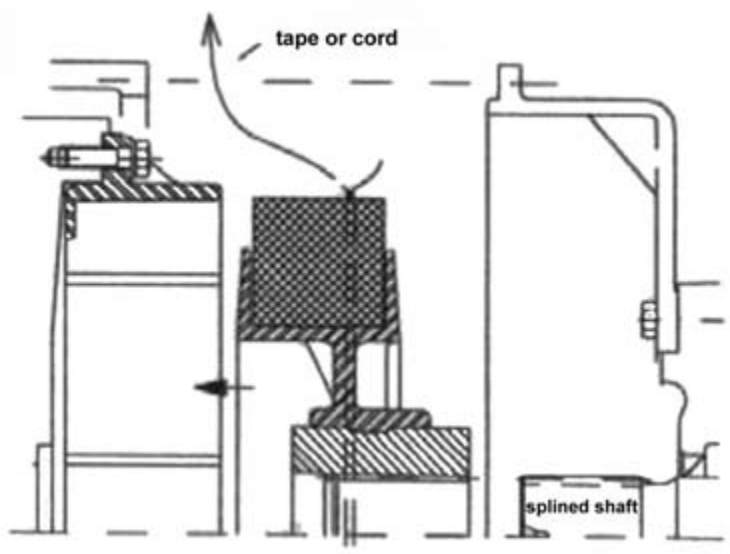


Figure 125. Coupling into Flywheel Flange

4. Then push the output side of the coupling with the gear into the outer flange. If necessary apply some lubricant on the outer flange. Suitable lubricants are soap water, detergents, etc., but no oil or grease. In case a tape or cord had to be used, push the coupling only half way together and then take the long end of the tape or cord and pull it away. Then grease or oil the gear shaft and plug it into the coupling spline.

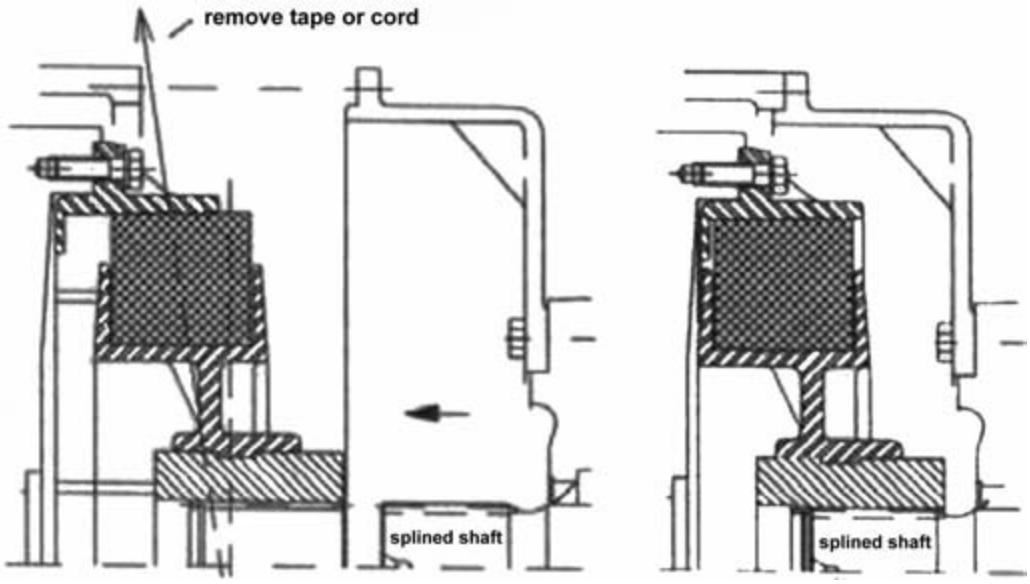


Figure 126. Final Assembly

5. Bolt the gear flange to the flywheel housing.

Note: When bolting the gear flange to the flywheel housing, make sure that no axial thrust is exerted to the coupling by tightening of the bolts. Before the engine is started the first time, check that the crankshaft has endplay, otherwise serious damage may occur to the engine.

Propeller Shaft

Before any attempt to align the engine and gearbox to the propeller shaft, proper alignment of the propeller shaft must be determined. This includes alignment of the propeller shaft through all struts and intermediate bearings. Failure to properly align the propeller shaft may result in premature wear on bearings, vibrations, or possible damage to other components.

If the length of the shaft from the last support bearing to the gearbox is excessive or a flexible stuffing box is used, the shaft must be centered prior to engine and gearbox to propeller shaft alignment.

Transmission Controls

⚠ CAUTION

Transmission controls must be checked for proper function and alignment after any transmission selector valve is properly indexed in relation to the operator's control lever. Failure to do so could cause control system malfunction, resulting in personal injury and or damage to equipment and property.

See specific marine transmission installation drawings for detail and dimensional information needed for the proper installation of control linkages, power engaging devices, or electrical connections.

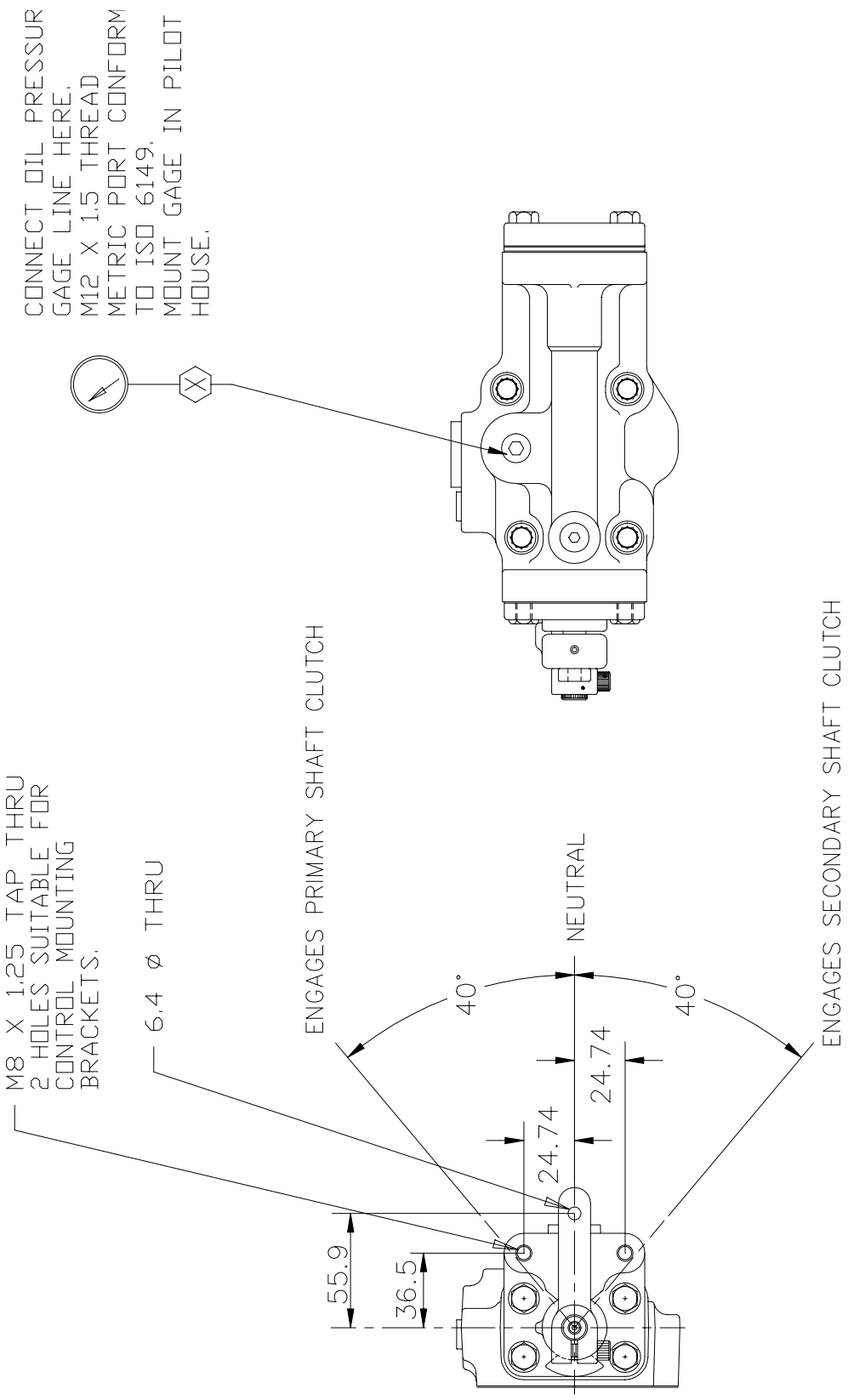


Figure 127. Mechanical Control Valve Installation Specifications

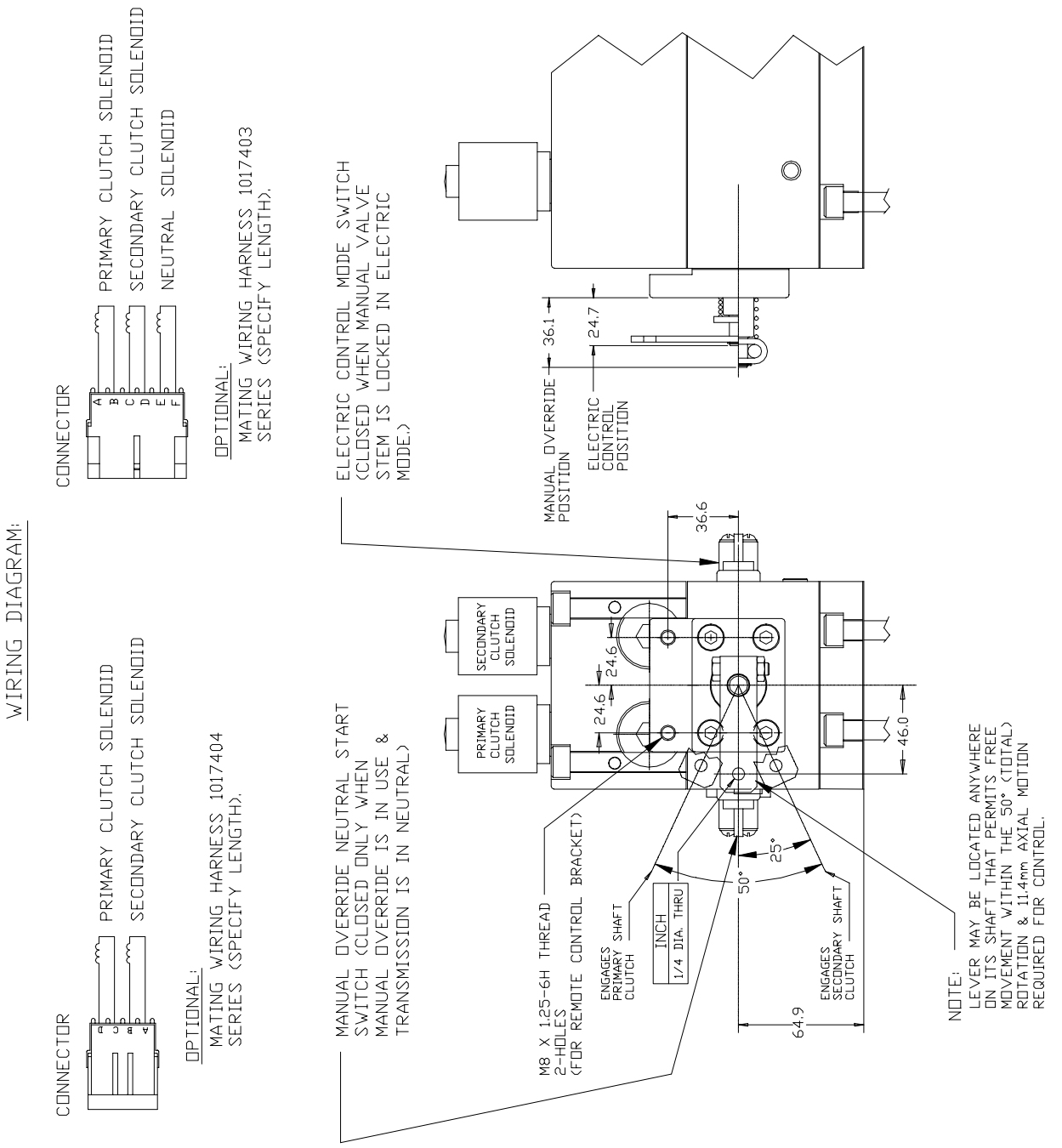


Figure 128. Optional Electric Control Valve Installation Specifications

Mechanical Controls

Movement of the operator's selector lever to the forward, neutral or reverse position must result in the transmission control valve selector being positioned in the forward, neutral or reverse detent location. Cables and linkages must be supported properly and not have any excessive slack that will allow relative movement between the operators selector lever and the transmission control valve selector lever.

Power Controls

Selector valve positioning devices must be installed so that full travel of the actuating cylinder places the transmission selector valve in the detent position for forward or reverse, as selected, without exerting pressure on the rotational stop on the selector valve stem. Selecting neutral must place the selector valve in the neutral detent position. Improper installation of power engaging devices could cause failure of the selector valve stop permitting improper positioning of the selector valve and resulting in control malfunction.

Electrical Controls

All electrical wires and connectors must be adequately supported to prevent rubbing, chafing, or distress from relative movement. All electrical connections must be tight and free from any corrosion.

Final Checks

Be sure the transmission is filled with oil before starting. See Description and Specifications and Preventative Maintenance for proper oil and filling procedure.

Special Tools

List of Special Tools

The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continue on the following page.

- ❑ Recommended Pump Set and Fluids
- ❑ THAP 300 SKF Air-Driven Pump Set
- ❑ T-18050-96 Bearing Driver
- ❑ T-18050-116 Bearing Cup Driver
- ❑ T-18050-120 Seal Driver
- ❑ T-18050-152 Bearing Seat Driver
- ❑ T-18050-607 Bearing Driver
- ❑ T-18050-609 Driver
- ❑ T-18050-610/612 Bearing Driver
- ❑ T-19998 Spring Retainer Hold Down
- ❑ T-20023 Output Gear and Shaft Puller (Sh. 1 of 4)
- ❑ T-20023 Output Gear and Shaft Puller (Sh. 2 of 4)
- ❑ T-20023 Output Gear and Shaft Puller (Sh. 3 of 4)
- ❑ T-20023 Output Gear and Shaft Puller (Sh. 4 of 4)
- ❑ T-21302-1 Sleeve for Runout Check
- ❑ T-21347 Seal Protector
- ❑ T-21347-1 Seal Driver

- ❑ Lifting Bracket for Clutch Removal in Boat
- ❑ T-18050-772 Bearing Driver
- ❑ T-19987 Output Gear Lifting Fixture

Recommended Pump Set and Fluids

Twin Disc recommends the following products for use in the assembly and removal of tapered shafts using the oil injection method:

THAP 300 Air-Driven Pump Set

This set consists of the air-driven pump with accessories, such as an adapter block, pressure gauge, high pressure pipe, or pressure hose with quick connection couplings and connection nipples. The set includes one of each: air-driven pump [THAP 300], adapter block [226402], pressure gauge [1077589] and high pressure pipe (2m/6.5 ft.) [227957A].

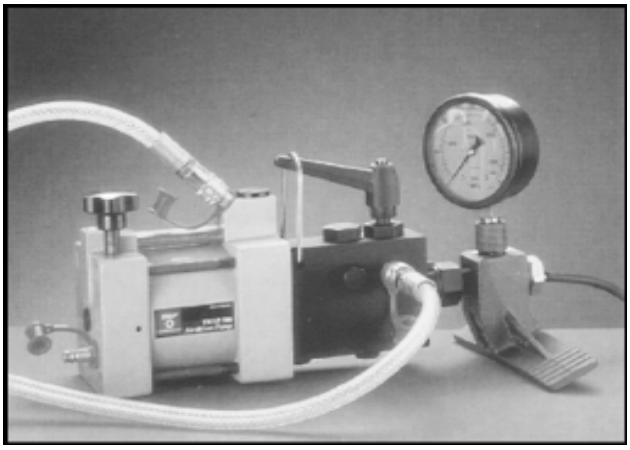


Figure 129. THAP 300 Air-driven Pump Set

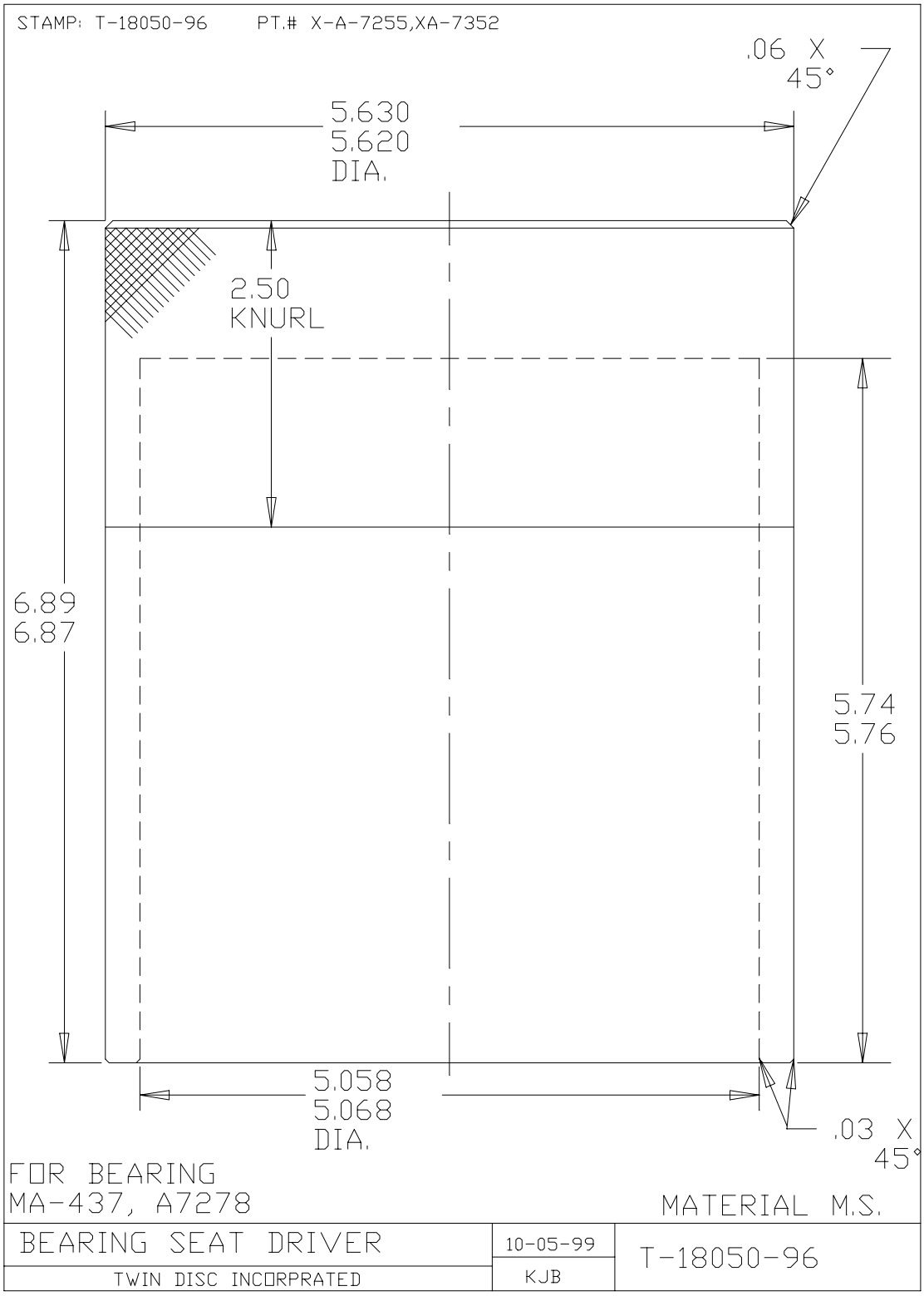
Mounting Fluid LHMF 300 and Dismounting Fluid LHDF 900

SKF LHMF 300 and LHDF 900 are recommended when using SKF hydraulic equipment like hydraulic pumps, HMV nuts, oil injection equipment, etc. The fluids contain anticorrosives and are non-aggressive to seal material like nitrile rubber, Buna N (Perbunan), chrome, leather, PTFE, etc. SKF LHMF 300 and LHDF 900 are available in 5 liter (5.3 qt.) cans. Designation: LHMF 300/5 and LHDF 900/6.

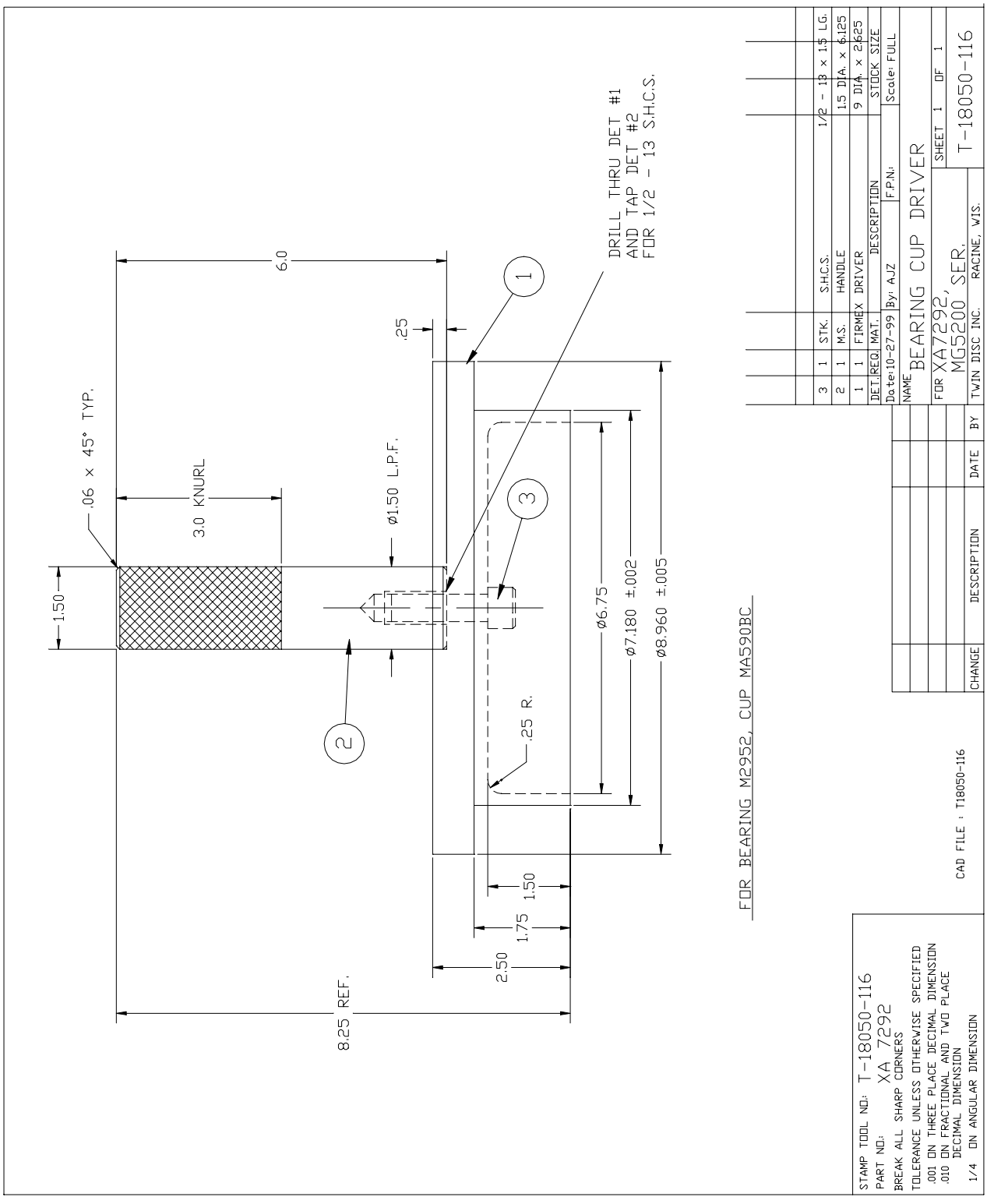
Figure 130. SKF LHMF 300 and LHDF 900

Note: Order Through Your Local Authorized SKF Distributor.

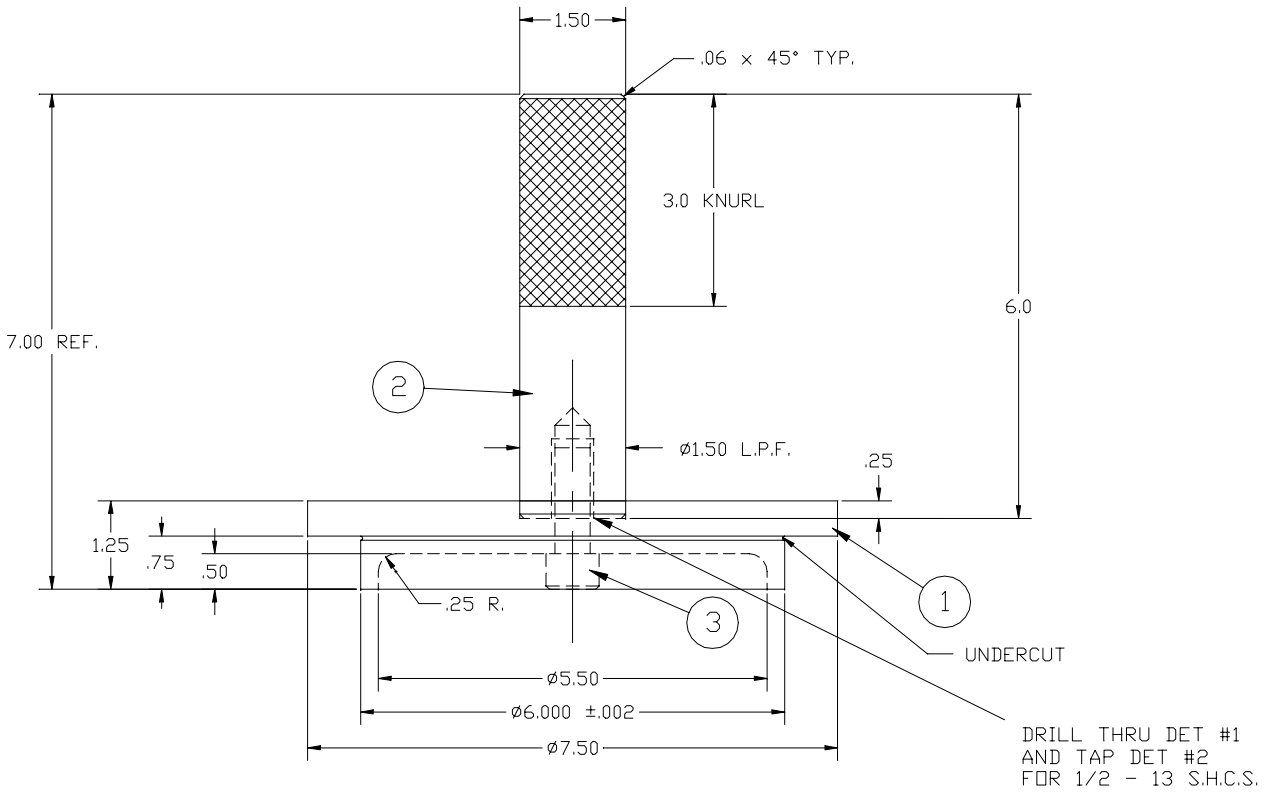
Driver T-18050-96



Bearing Cup Driver T-18050-116



Seal Driver T-18050-120



FOR SEAL MA440

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
3	1	STK.	S.H.C.S.	1/2 - 13 x 1.25 LG.
2	1	M.S.	HANDLE	1.5 DIA. x 6.125
1	1	FIRMEX	DRIVER	7.5 DIA. x 1.375

Date: 10-28-99 | By: AJZ | F.P.N.: | Scale: FULL

NAME SEAL DRIVER

FOR XA7255, MG5200 SER.

SHEET 1 OF 1

TWIN DISC INC. RACINE, WIS.

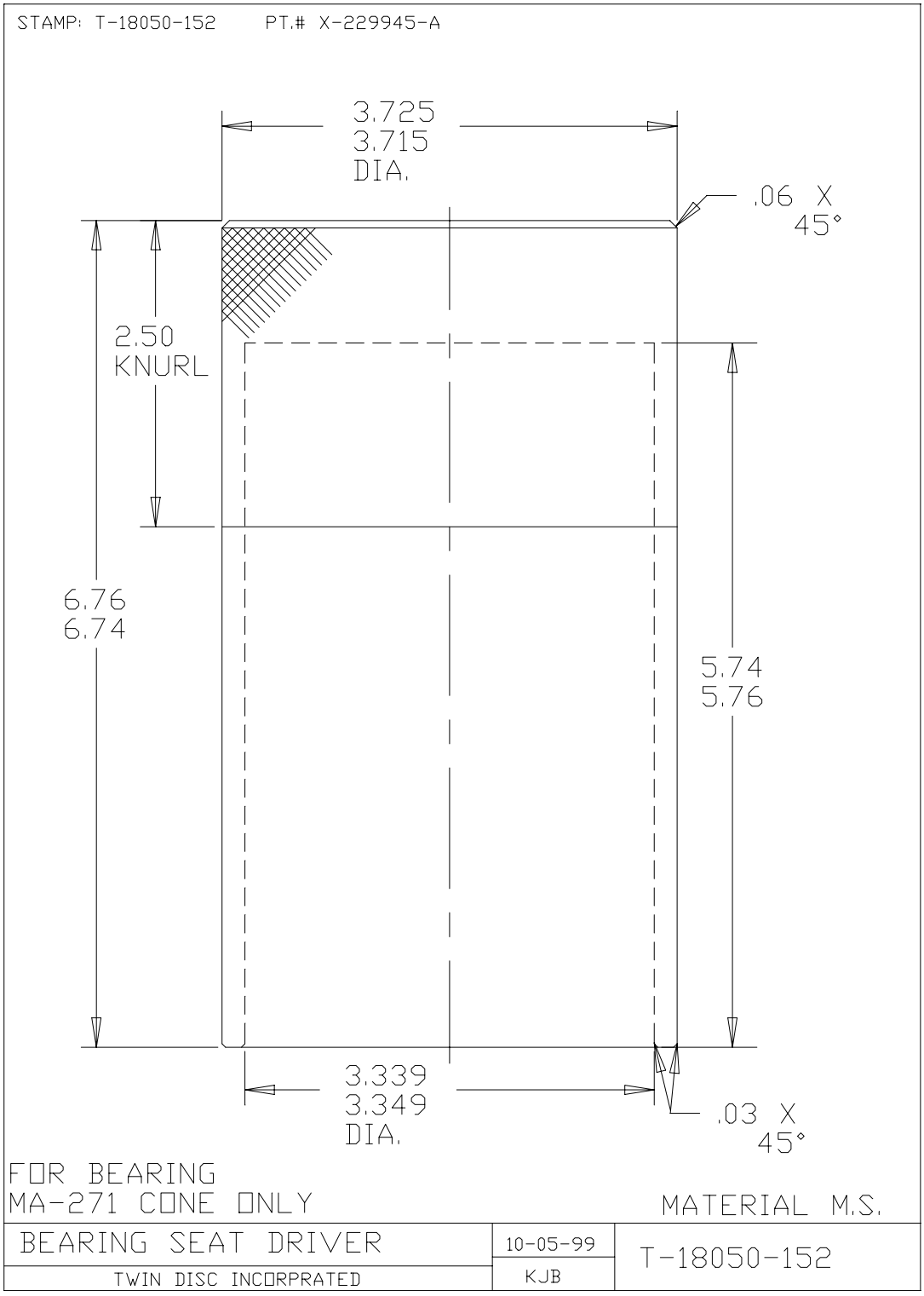
T-18050-120

CHANGE	DESCRIPTION	DATE	BY

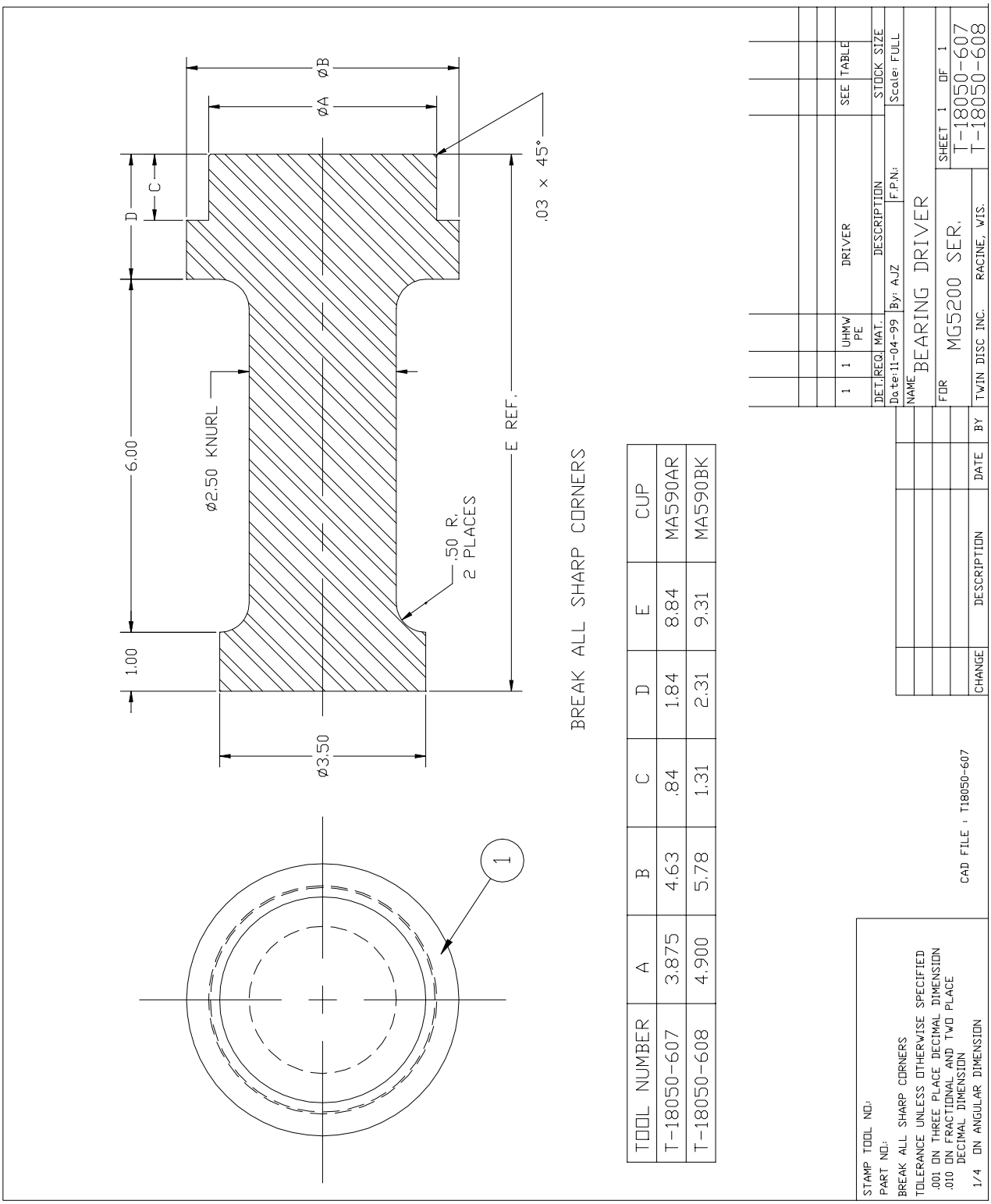
STAMP TOOL NO.: T-18050-120
PART NO.: XA 7255
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : T18050-120

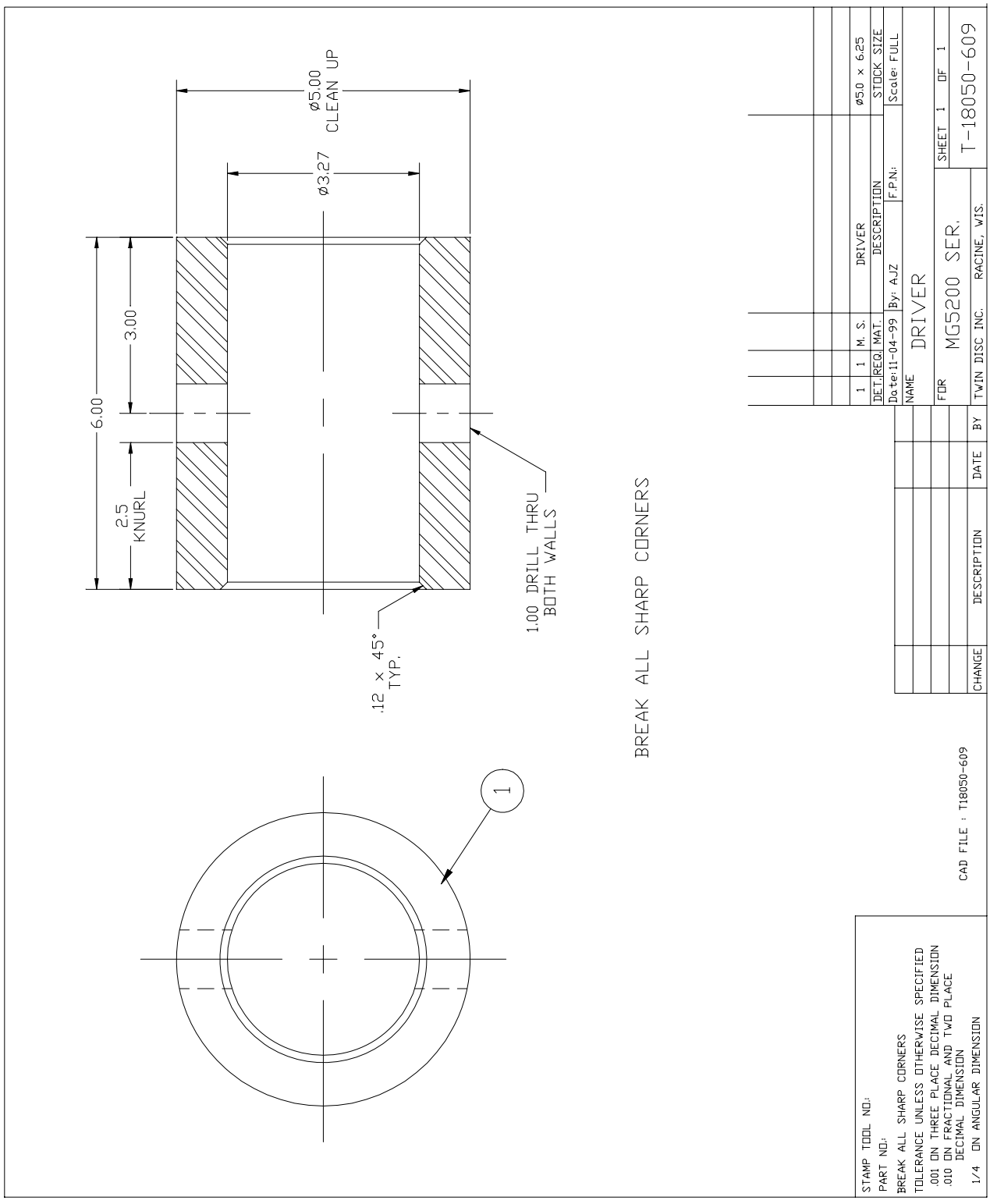
Bearing Seat Driver T-18050-152



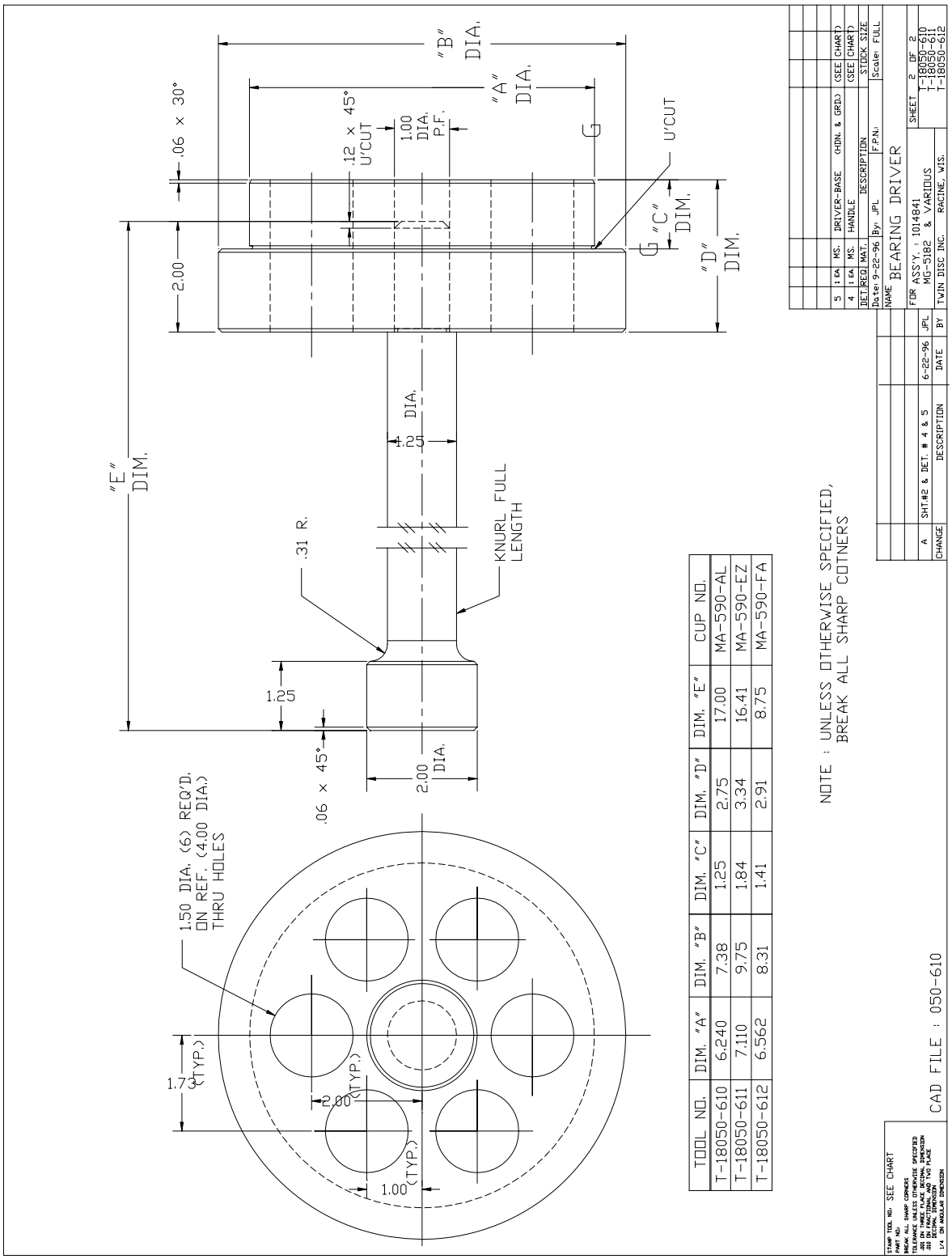
Bearing Driver T-18050-607


ØB
ØA
D
C
.03 x 45°
6.00
Ø2.50 KNURL
E REF.
.50 R.
2 PLACES
1.00
Ø3.50
1
BREAK ALL SHARP CORNERS
TOOL NUMBER | A | B | C | D | E | CUP
T-18050-607 | 3.875 | 4.63 | .84 | 1.84 | 8.84 | MA590AR
T-18050-608 | 4.900 | 5.78 | 1.31 | 2.31 | 9.31 | MA590BK
STAMP TOOL NO.:
PART NO.:
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION
CAD FILE : T18050-607
CHANGE | DESCRIPTION | DATE | BY
1 1 UHMW PE DRIVER SEE TABLE
DET.REQ. MAT. DESCRIPTION STOCK SIZE
Date:11-04-99 By: AJZ F.P.N.: Scale: FULL
NAME BEARING DRIVER
FOR MG5200 SER.
SHEET 1 OF 1
T-18050-607
T-18050-608
TWIN DISC INC. RACINE, WIS.

Driver T-18050-609

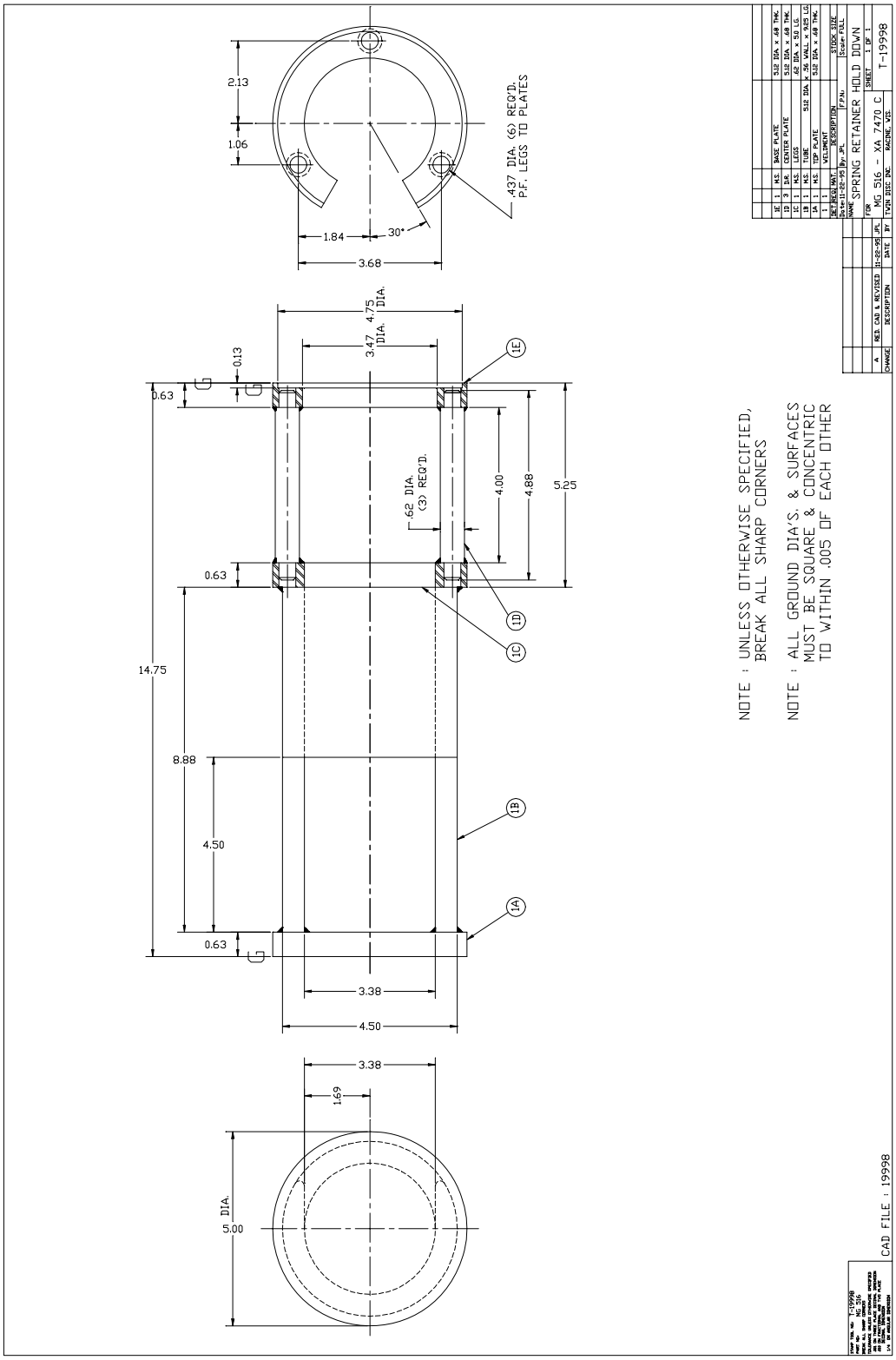


Bearing Driver T-18050-610/612

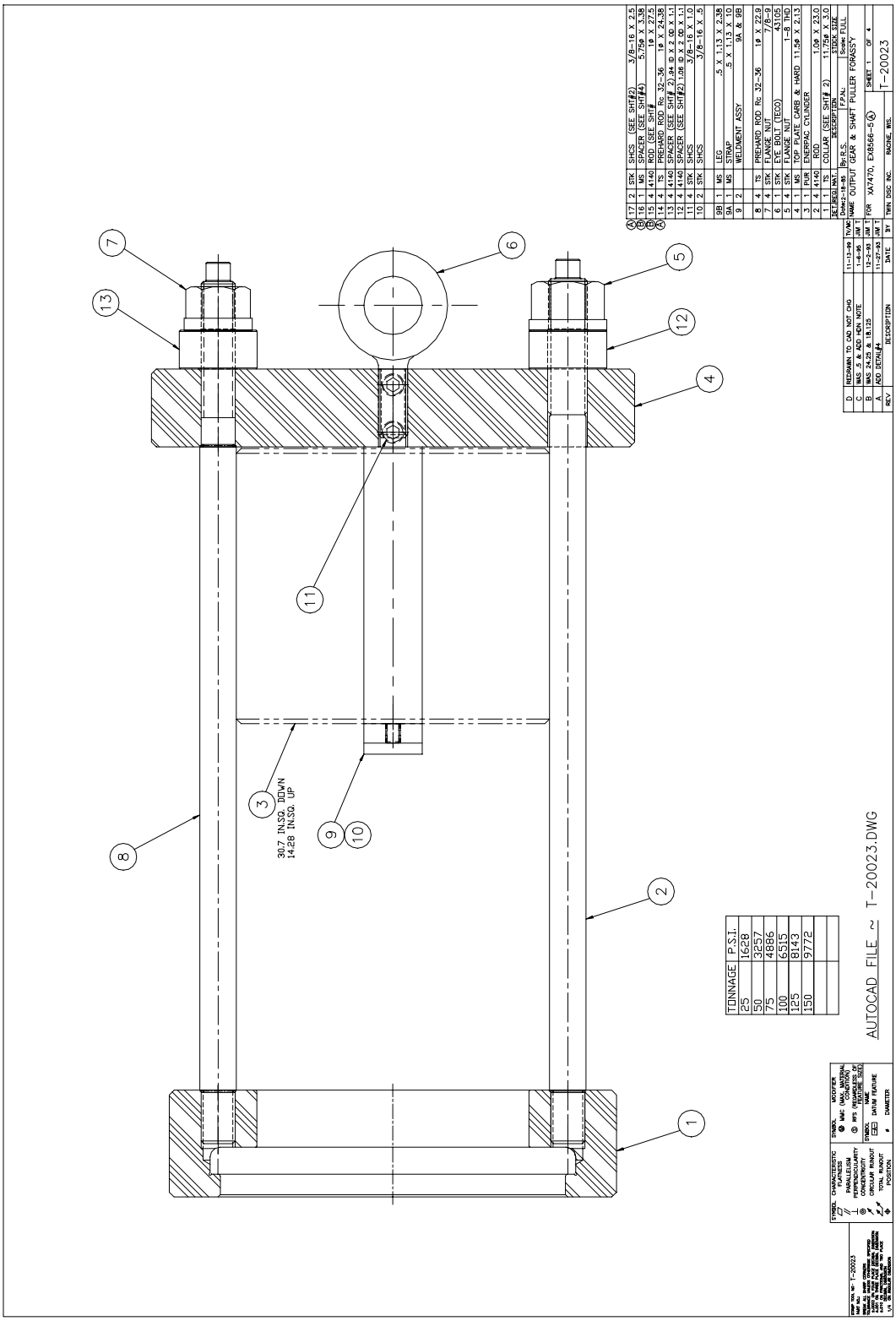

"B" DIA.
"A" DIA.
.06 x 30°
.12 x 45° U'CUT
1.00 DIA. P.F.
U'CUT
"C" DIM.
"D" DIM.
2.00
"E" DIM.
1.25 DIA.
.31 R.
KNURL FULL LENGTH
1.25
.06 x 45°
2.00 DIA.
1.50 DIA. (6) REQ'D. ON REF. (4.00 DIA.) THRU HOLES
1.73 (TYP.)
2.00 (TYP.)
1.00 (TYP.)
NOTE : UNLESS OTHERWISE SPECIFIED, BREAK ALL SHARP CORNERS
CAD FILE : 050-610
STAMP TOOL NO. SEE CHART
PART NO.
BREAK ALL SHARP EDGES
REMOVE BURRS
TOLERANCES UNLESS OTHERWISE SPECIFIED
.XXX DN THREE PLACE DECIMAL DIMENSION
.XX DN TWO PLACE DECIMAL DIMENSION
1/4 DN ANGULAR DIMENSION
5 1 EA. MS. DRIVER-BASE (HDN. & GRD.) (SEE CHART)
4 1 EA. MS. HANDLE (SEE CHART)
DET. REQ'D MAT. DESCRIPTION STOCK SIZE
Date: 9-22-96 By: JPL F.P.N.: Scale: FULL
NAME BEARING DRIVER
FOR ASS'Y. : 1014841 MG-5182 & VARIOUS
SHEET 2 OF 2
T-18050-610 T-18050-611 T-18050-612
TWIN DISC INC. RACINE, WIS.
A SHT.#2 & DET. # 4 & 5 6-22-96 JPL
CHANGE DESCRIPTION DATE BY

TOOL NO.	DIM. "A"	DIM. "B"	DIM. "C"	DIM. "D"	DIM. "E"	CUP NO.
T-18050-610	6.240	7.38	1.25	2.75	17.00	MA-590-AL
T-18050-611	7.110	9.75	1.84	3.34	16.41	MA-590-EZ
T-18050-612	6.562	8.31	1.41	2.91	8.75	MA-590-FA

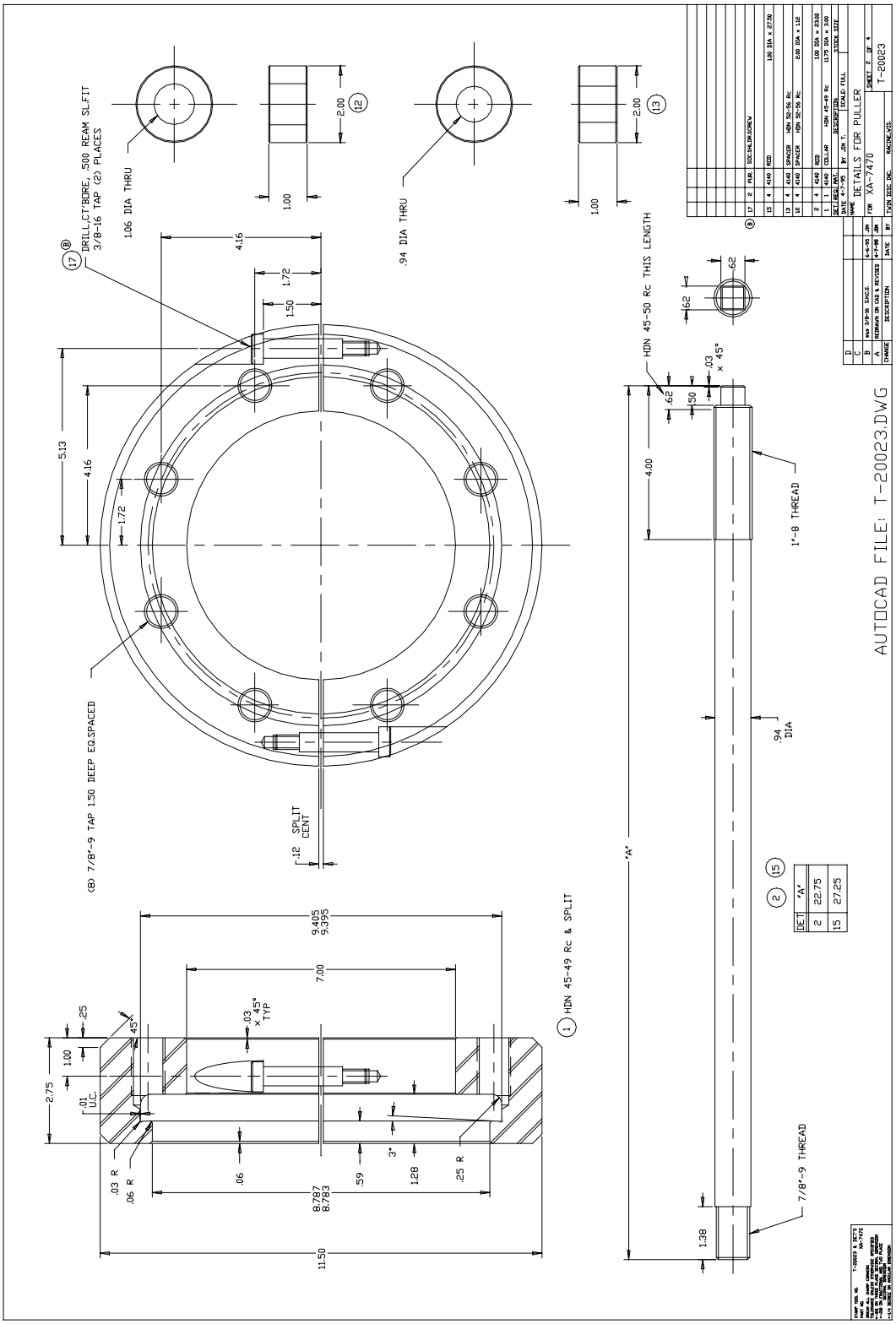
Spring Retainer Hold Down T-19998



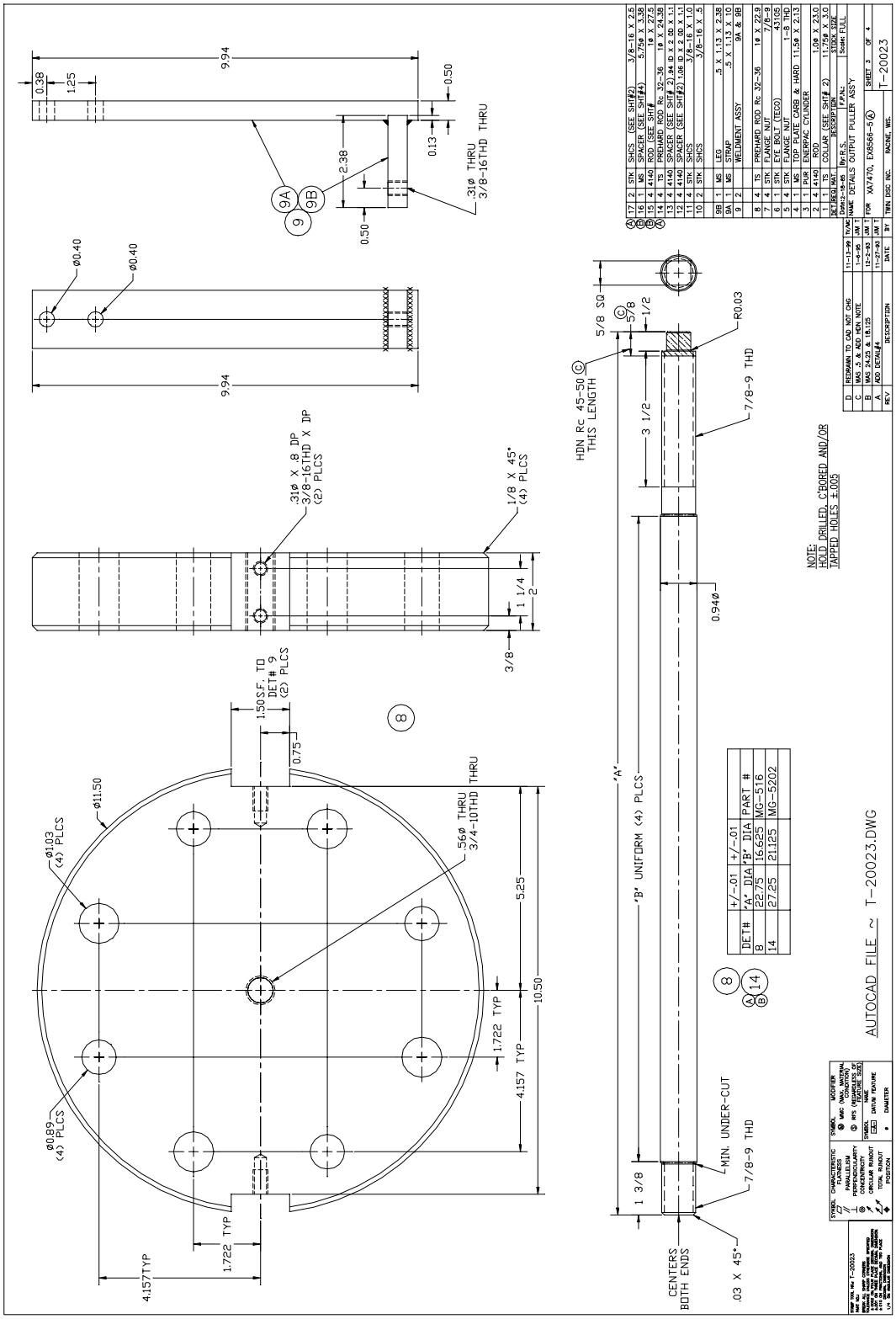
Output Gear & Shaft Puller for Assembly T-20023 - Sh. 1 of 4



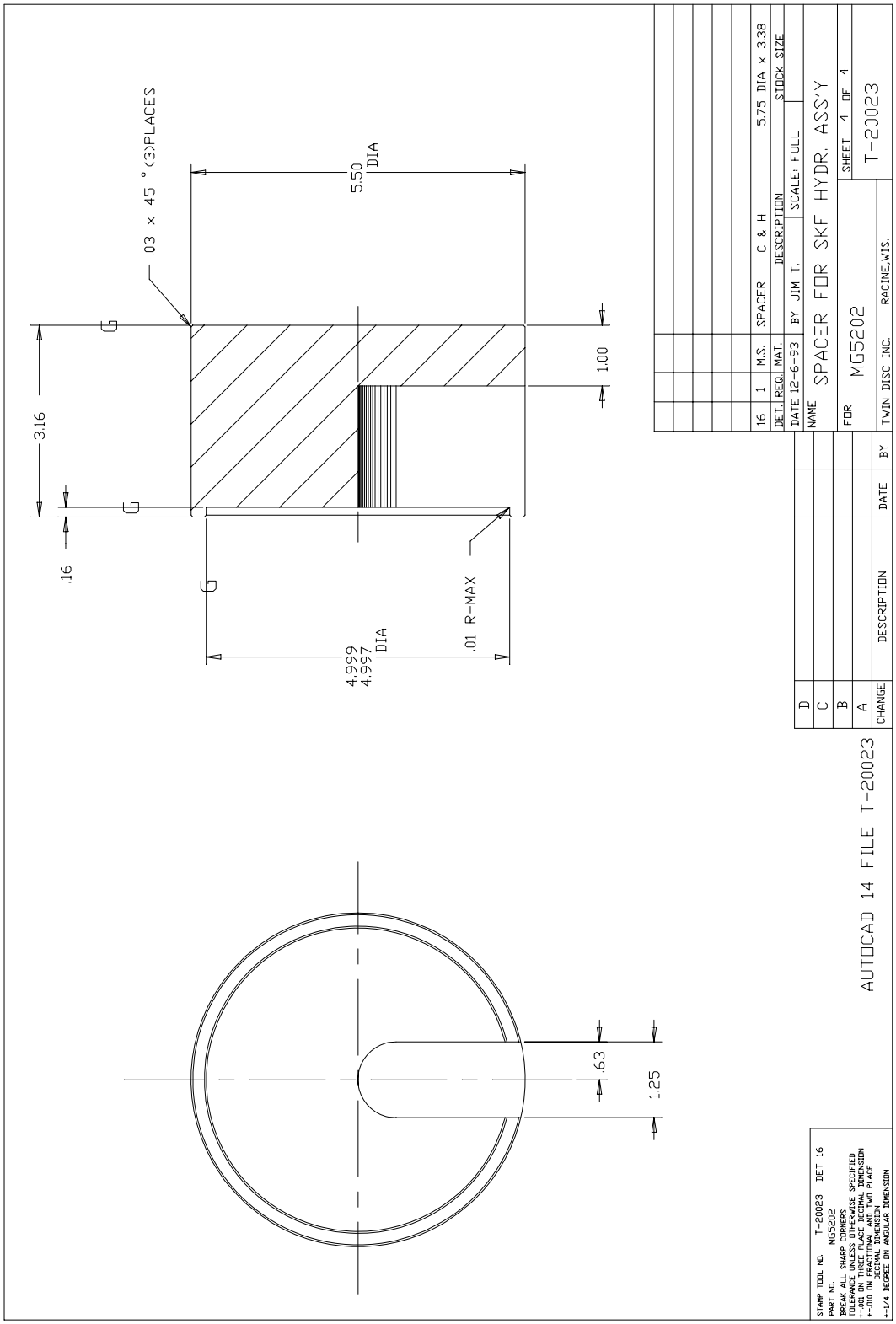
Details for Puller T-20023 - Sh. 2 of 4



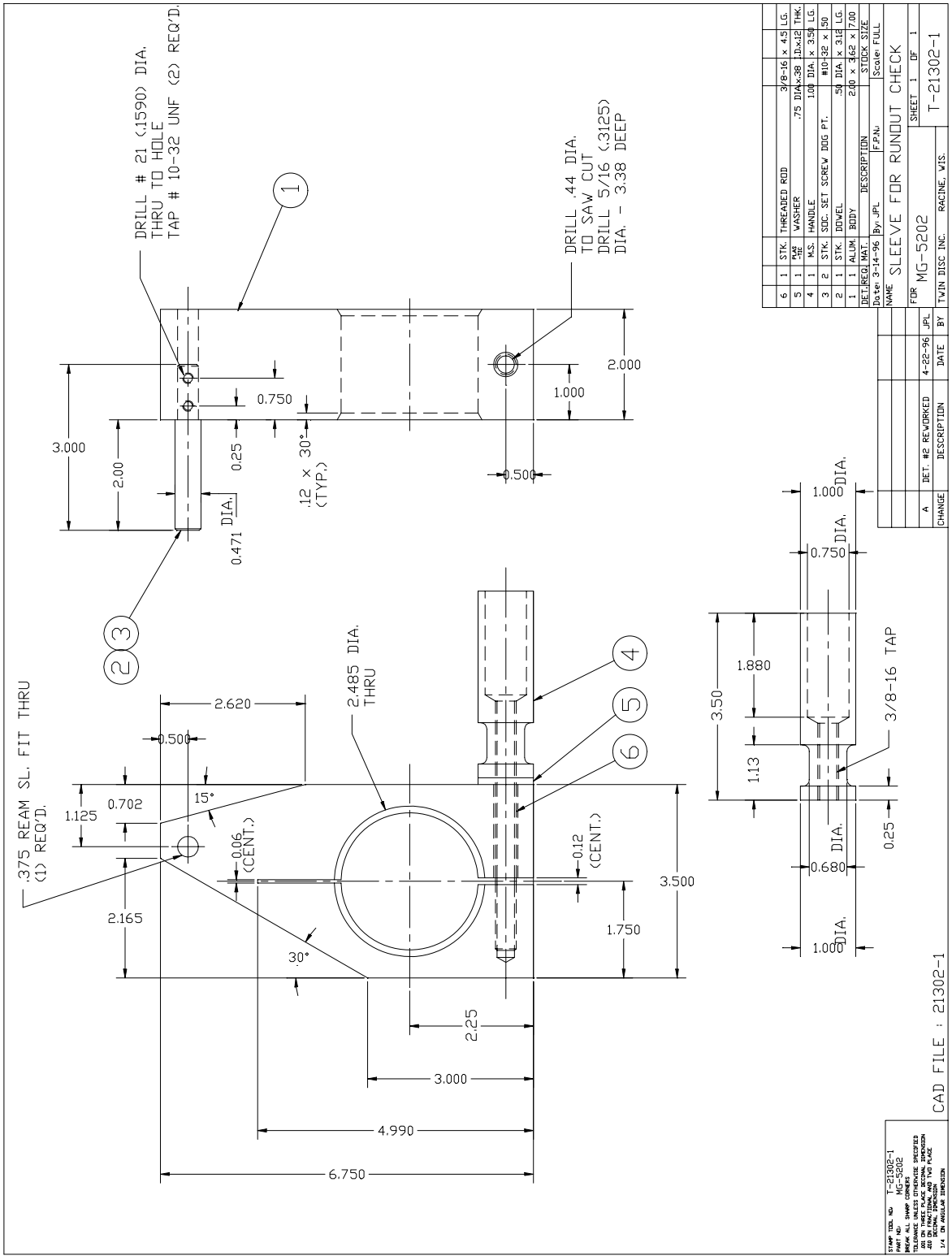
Details for Puller T-20023 - Sh. 3 of 4



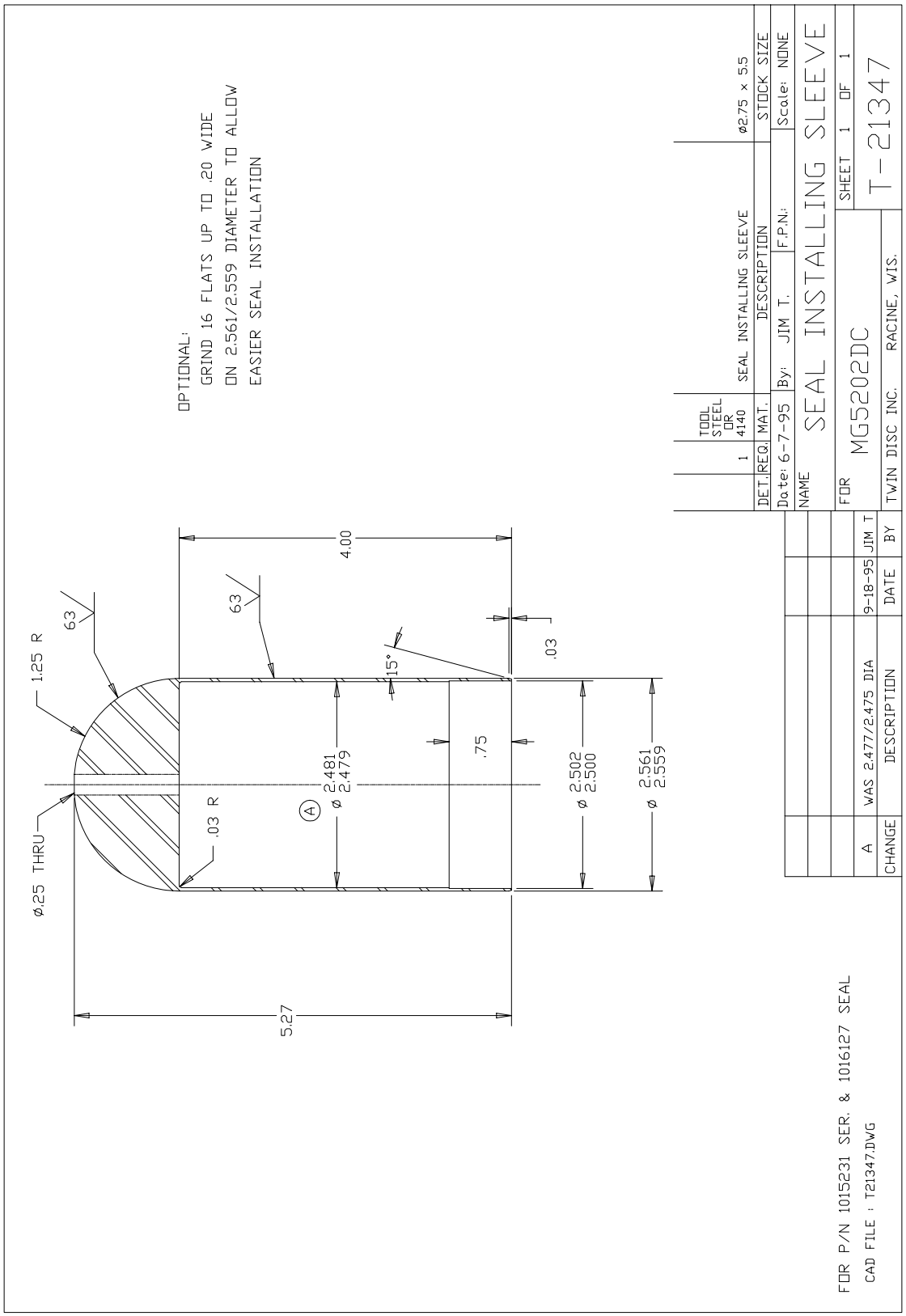
Spacer for SKF Hydraulic Assembly T-20023 - Sh. 4 of 4



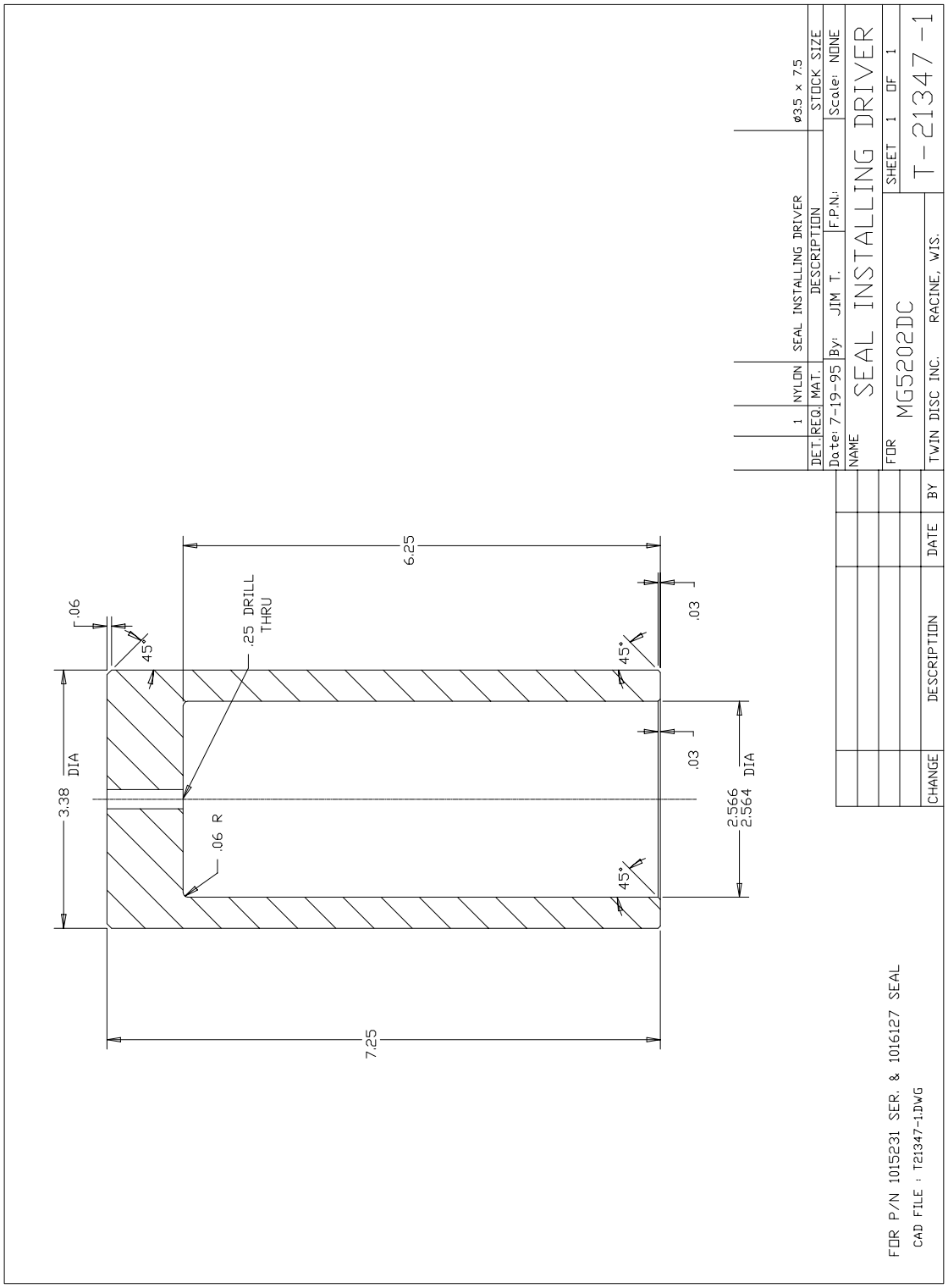
Sleeve for Runout Check T-21302-1



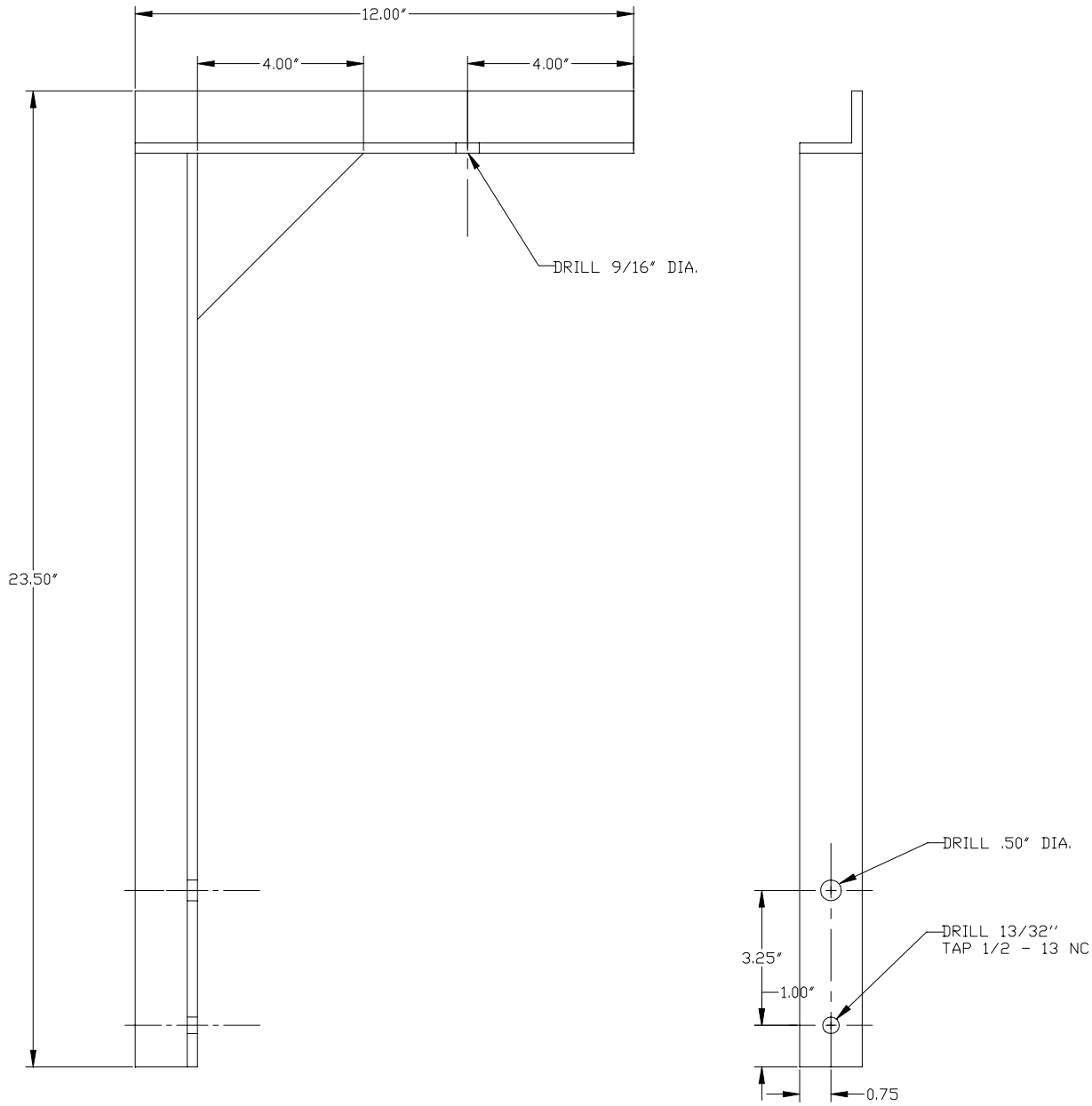
Oil Seal Protector T-21347

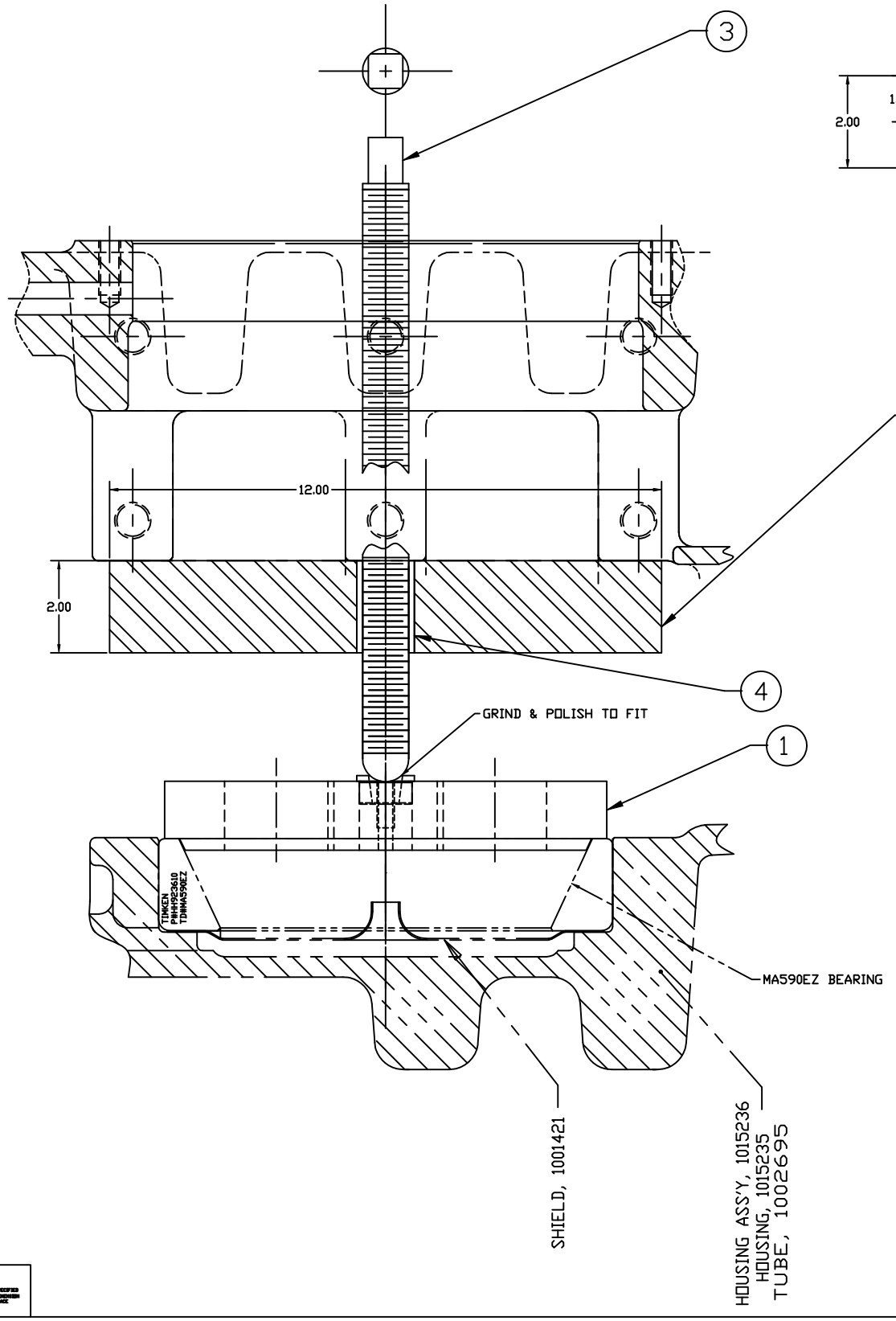


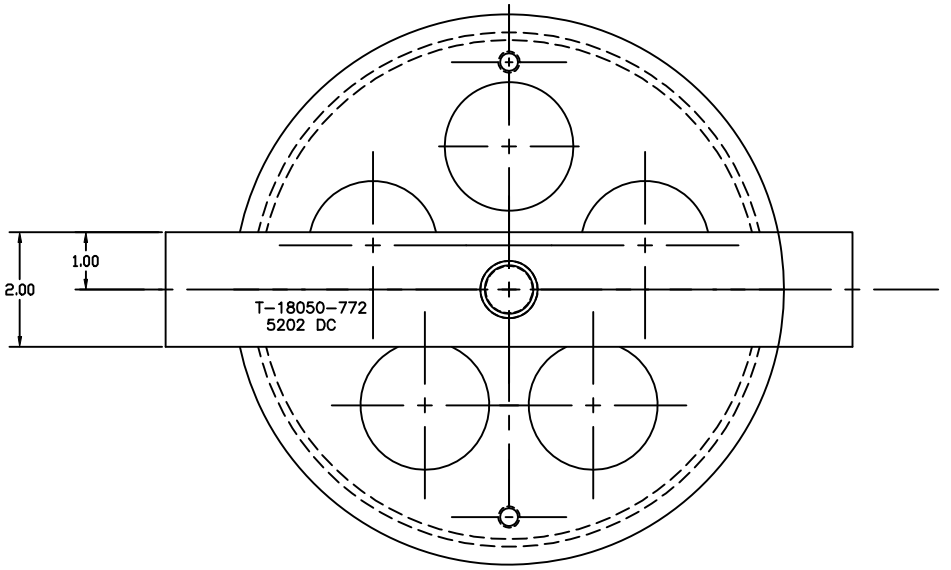
Oil Seal Driver T-21347-1

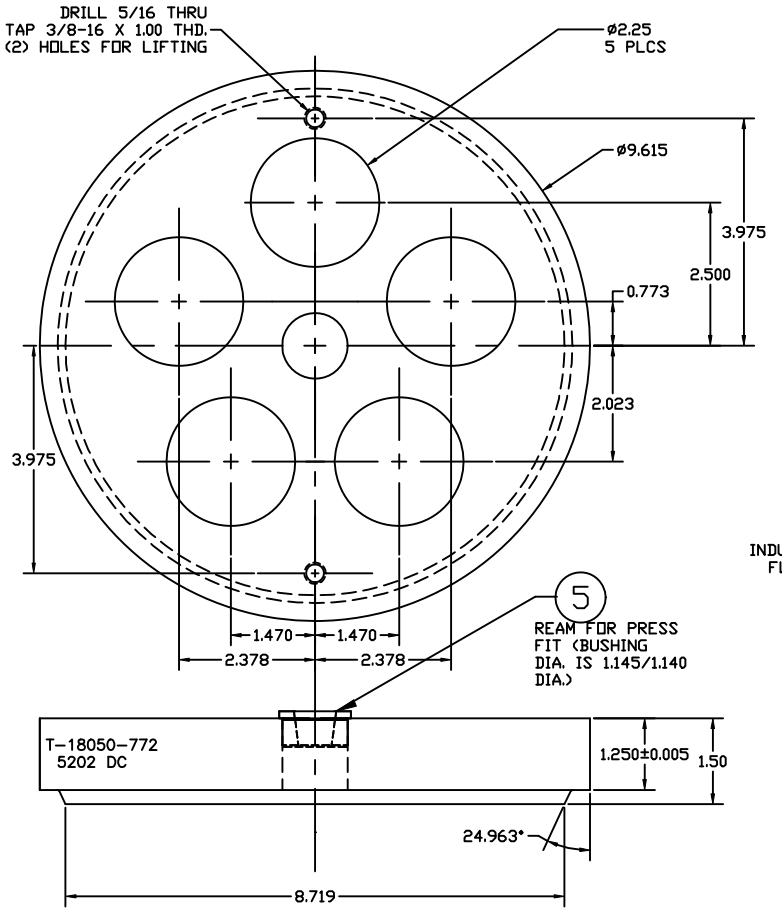


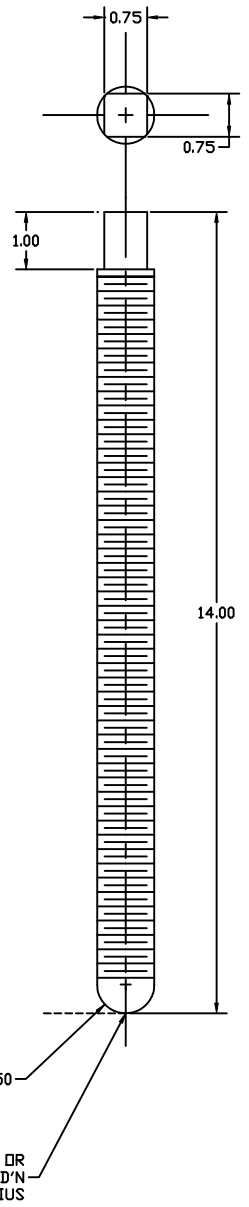
Lifting Bracket for Clutch Removal in Boat











5	1	PUR.	TECO #54973 TAPER INDEX BUSHING
4	1	PUR.	STEEL THREADED INSERT 1-8
3	1	PUR.	DRILL ROD 1-8 X 14.2 LGTH
2	1	ALUM.	BLOCK 2 X 2 X 12
1	1	ALUM.	BASE 9.8 DIA X 1-1/2
DET.	REQ'I	MAT.	DESCRIPTION STOCK SIZE

Date: 4/10/01 By: THV F.P.N.: Scale: FULL

NAME: BEARING DRIVER FOR CUP

FOR: MG-5202 DC

SHEET 1 OF 1

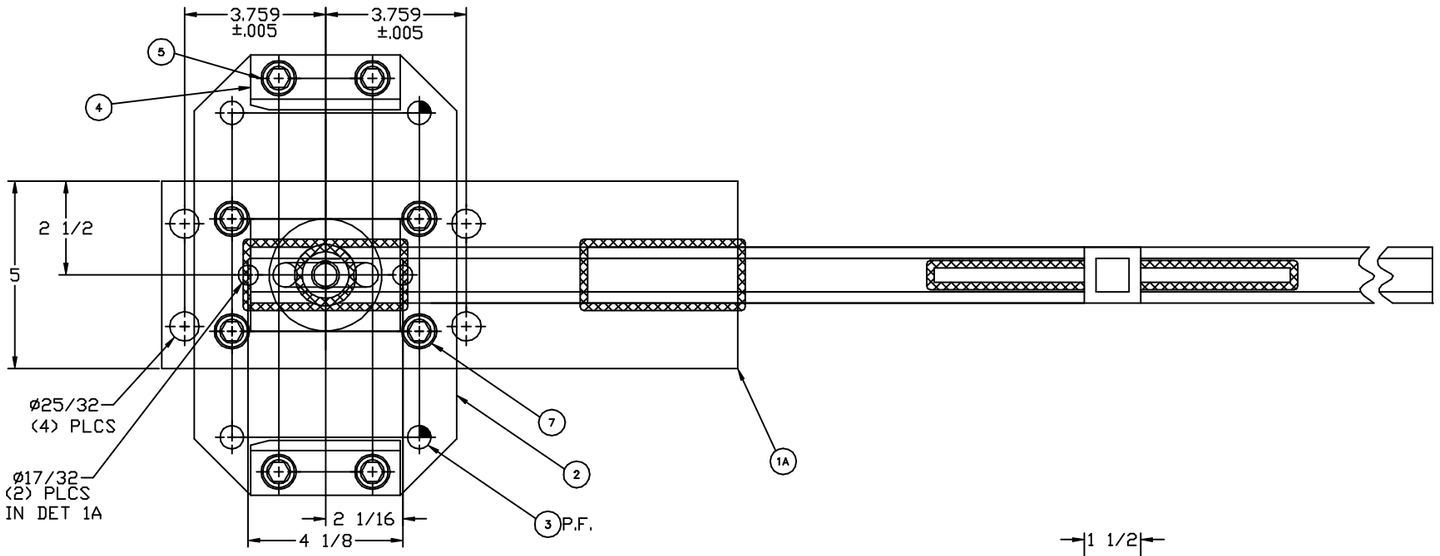
T-18050-772

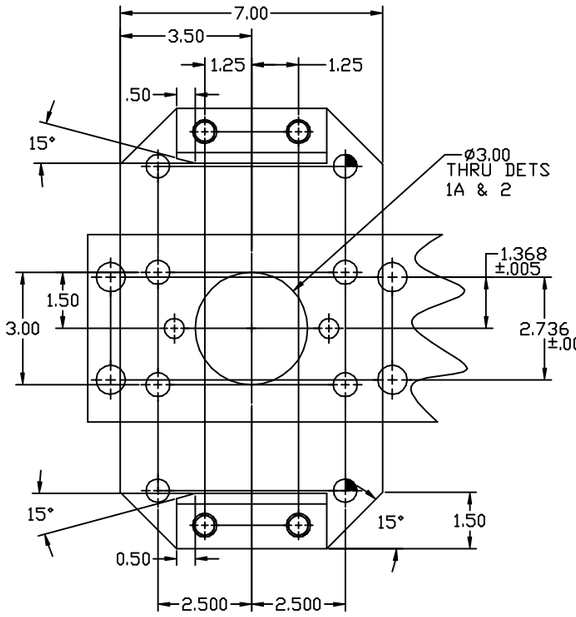
TWIN DISC INC. RACINE, WIS.

REV	DESCRIPTION	DATE	BY
A	-	-	-

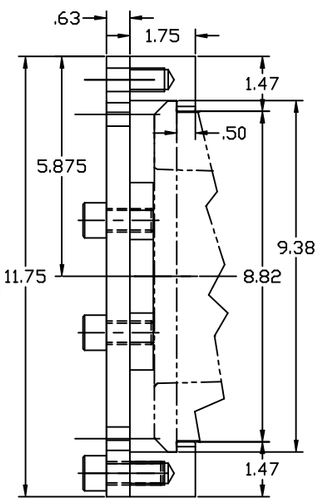
STAMP TOOL NO: T-18050-772
PART NO: 5202 DC
BREAK ALL SHARP EDGES
TOLERANCE UNLESS OTHERWISE SPECIFIED
.XXX ON THREE PLACE DECIMAL DIMENSION
.XXX ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/64 ON ANGULAR DIMENSION

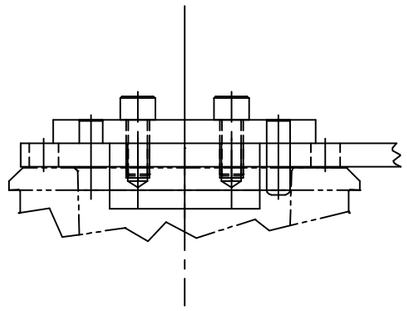
Notes

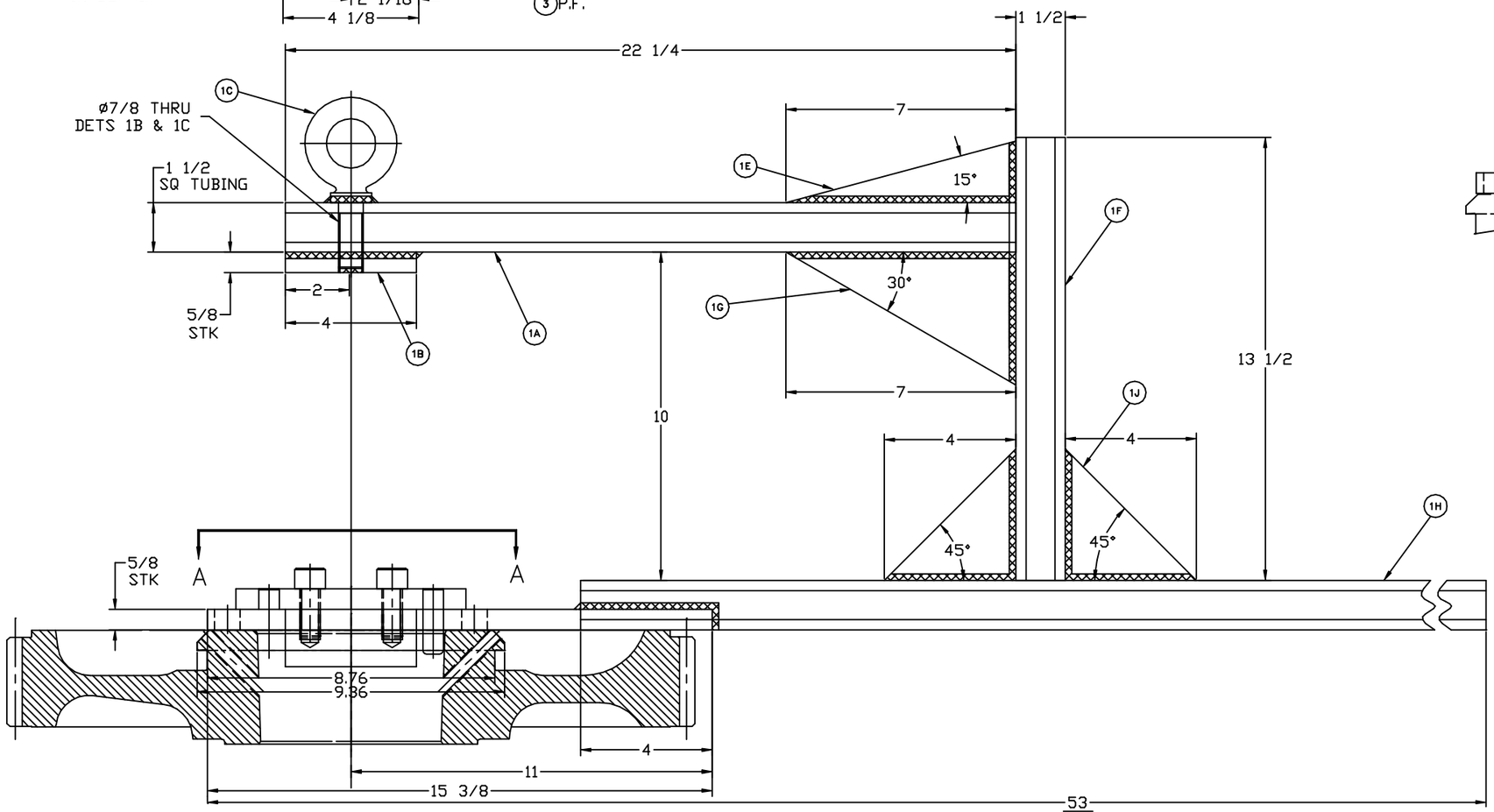




VIEW A-A







NOTE:
HOLD DRILLED, C'BORED AND/OR TAPPED HOLES ±.005

7	4	STK	SHCS	5/8-11 X 1.25
6	2	PUR	BALL L OCK PIN CL-10-BLPB-2	
5	4	STK	SHCS	5/8-11 X 1.5 LG
4	2	MS	GRIPPER (1) R.H. & (1) L.H. 1.5 X 1.8 X 4.13	
3	2	STK	DOWEL	5/8 DIA X 2
2	1	MS	HANGER CROSS PLATE	5/8 X 7 X 11.8
1H	1	MS	HANGER ARM	1.5 SQ X 41.5 TUBING
1G	1	MS	BOTTOM GUSSET (TOP ARM)	3/8 X 4 X 7
1F	1	MS	VERTICAL	1.5 SQ X 13.5 TUBING
1E	1	MS	GUSSET (TOP ARM)	3/8 X 2 X 7
1D	1	MS	EYE BOLT ARM	1.5 SQ X 24.5 TUBING
1C	1	STK	SHOULDER FORGED EYE BOLT	3/4-10
1B	1	MS	EYE BOLT PAD	5/8 X 3 X 4
1A	1	MS	CLAMP PLATE	5/8 X 5.0 X 15.40
1	1		WELDMENT DETS 1A-1H & 1J	

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
Date: 10-2-84		By: BOB SPATH	F.P.N.:	Scale: HALF

NAME OUT PUT GEAR LIFTING FIXTURE FOR ASSEMBLY DEPT 344

FOR XA7470, A7496A, A7491A, A7486A, 1002580, A7501A

SHEET 1 OF 1

TWIN DISC INC. RACINE, WIS.

T-19987

REV	DESCRIPTION	DATE	BY
D	REDRAWN TO AUTOCAD14	12-3-99	TMV

STAMP TOOL NO.: T-19987
PART NO.: XA7470
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
±.0002 ON FOUR PLACE DECIMAL DIMENSION
±.001 ON THREE PLACE DECIMAL DIMENSION
±.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

SYMBOL	CHARACTERISTIC
▱	FLATNESS
//	PARALLELISM
⊥	PERPENDICULARITY
◎	CONCENTRICITY
↗	CIRCULAR RUNOUT
↗↗	TOTAL RUNOUT
⌖	POSITION

SYMBOL	MODIFIER
Ⓜ	MMC (MAX. MATERIAL CONDITION)
Ⓢ	RFS (REGARDLESS OF FEATURE SIZE)

SYMBOL	NAME
-A-	DATUM FEATURE
ø	DIAMETER

AUTOCAD FILE ~ T-19987

Notes

Illustrations

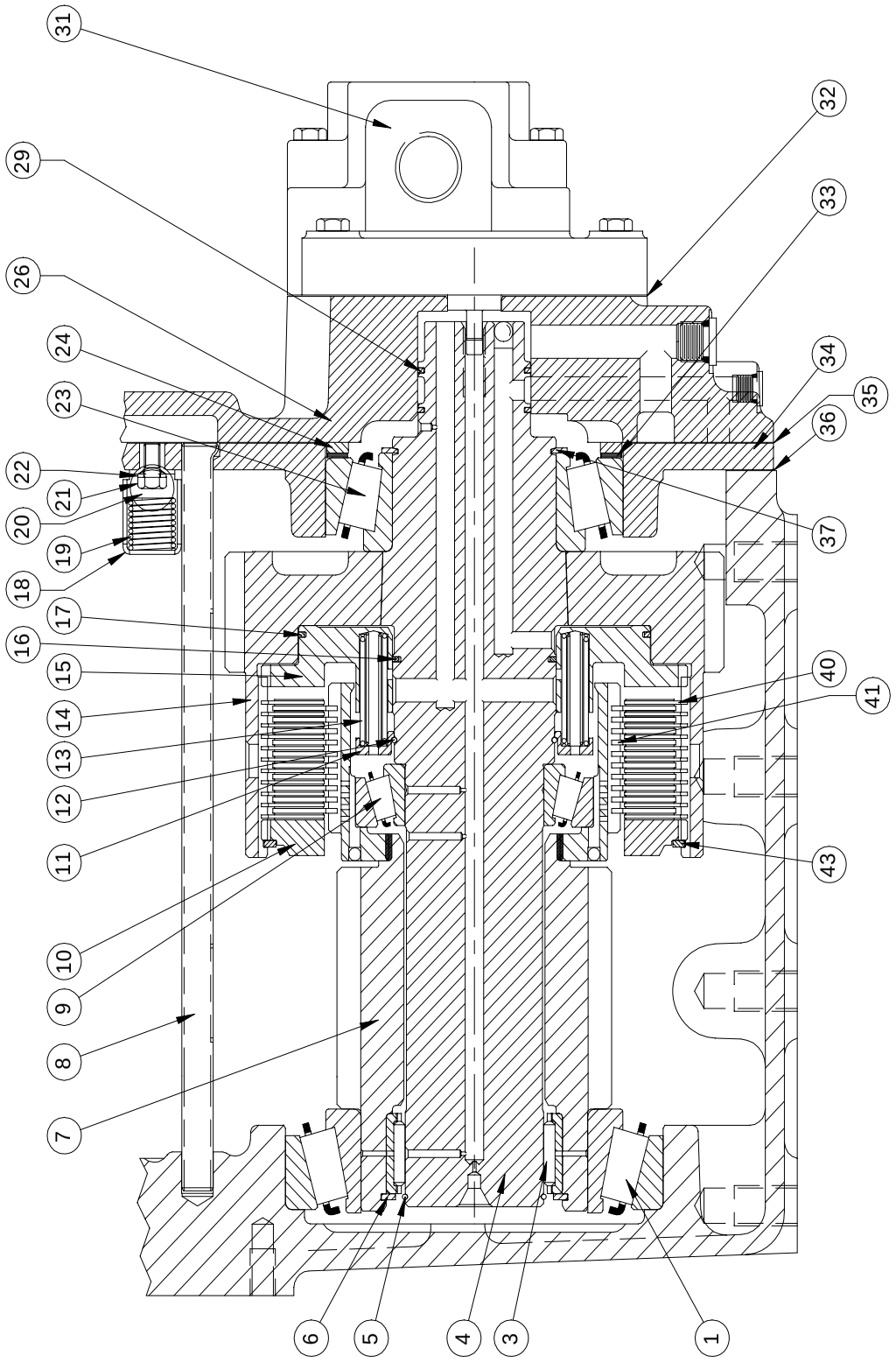
List of Illustrations

The following pages include illustrations that are specific to this model. The illustrations included are listed below.

Note: Any part numbers listed in the following illustrations are for reference only. Please refer to your bill of material for part numbers specific to your model.

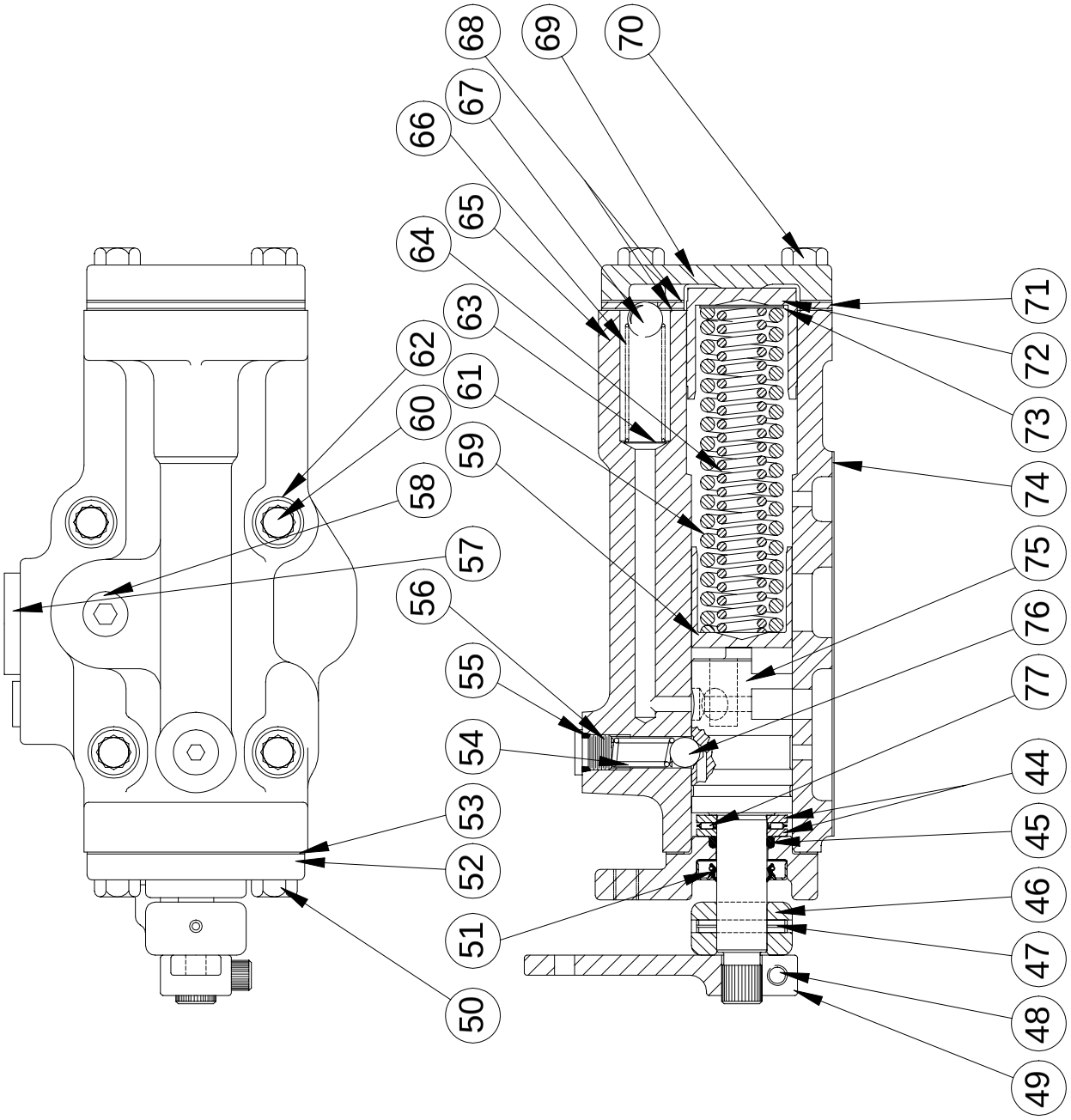
- ❑ Clutch Group
- ❑ Mechanical Selector Valve
- ❑ Suction Strainer
- ❑ Oil Filter
- ❑ Transmission Rear View
- ❑ Transmission Section View
- ❑ Electric Control Valve (optional equipment)
- ❑ Trolling Valve (optional equipment)

Clutch Group



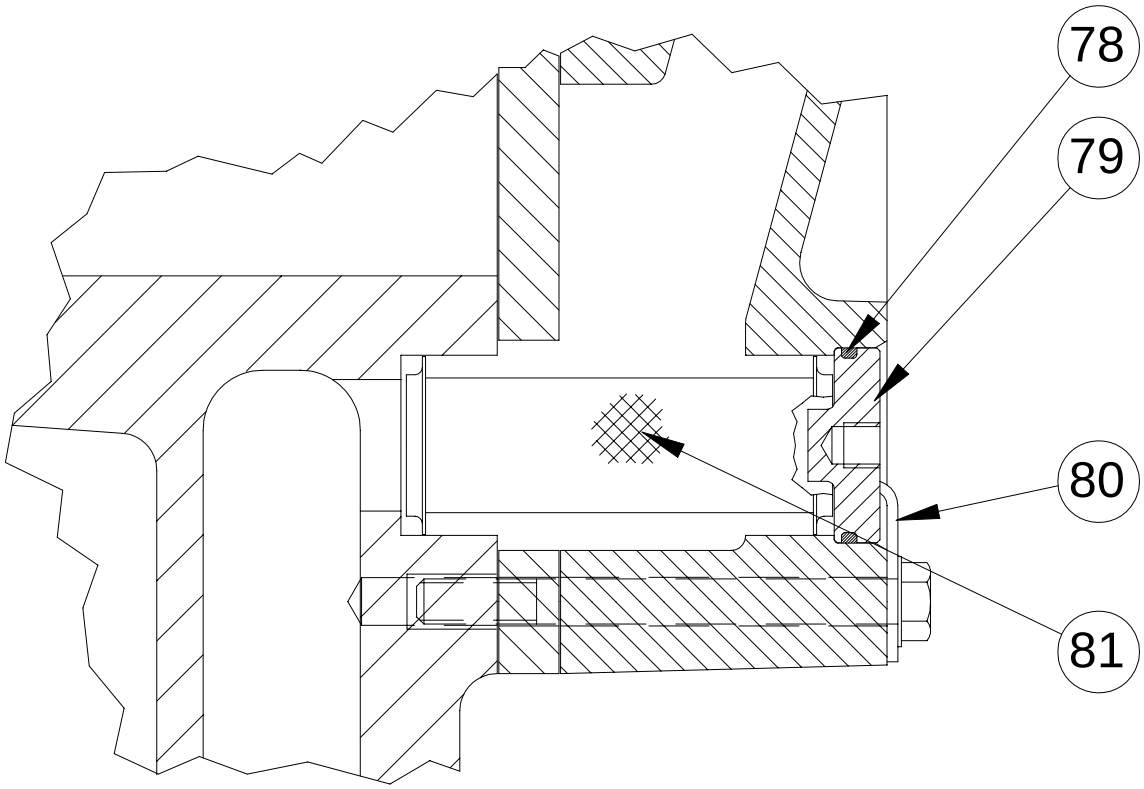
Item	Qty.	Description	Item	Qty.	Description
1	2	Bearing, tapered roller (primary & secondary shaft front bearing)	20	1	Ball, steel (lube relief valve)
3	2	Bearing, needle roller	21	2	Screw, hex head (lube relief valve)
4	1	Shaft assembly, secondary	22	2	Washer (lube relief valve)
5	2	Ring, external retaining (primary & secondary shaft at needle bearing)	23	2	Bearing, tapered roller (primary & secondary shaft rear bearing)
6	2	Ring, internal retaining (pinion at needle bearing	24	2	Spacer, bearing
7	2	Pinion assembly (primary & secondary)	26	1	Manifold
8	1	Tube, lube	29	2	Ring, piston (primary shaft)
9	2	Bearing, tapered roller (primary & secondary shaft, rear bearing)	31	1	Pump, oil
10	2	Backplate, clutch	32	1	Gasket, oil pump
11	2	Retainer, spring (primary & secondary shaft)	33	AR	Shim, bearing (.005", .007", .020")
12	2	Ring, external retaining	34	1	Carrier, bearing (primary & secondary shaft rear bearing)
13	32	Spring Assembly (primary & secondary clutch), consists of **1** spring *inner* & **1** spring *outer*	35	1	Gasket, manifold
14	1	Gear, transfer (secondary shaft, LH helix)	36	1	Gasket, bearing carrier
15	2	Piston, clutch	37	2	Ring, external retaining (primary and secondary shaft rear bearing)
16	2	Ring, piston (clutch piston inner)	40	20	Plate, clutch steel
17	2	Ring, piston (clutch piston outer)	41	22	Plate, clutch friction
18	1	Housing (lube relief valve)	43	2	Ring, internal retaining (clutch backplate)
19	1	Spring (lube relief valve)	-	-	-

Mechanical Selector Valve



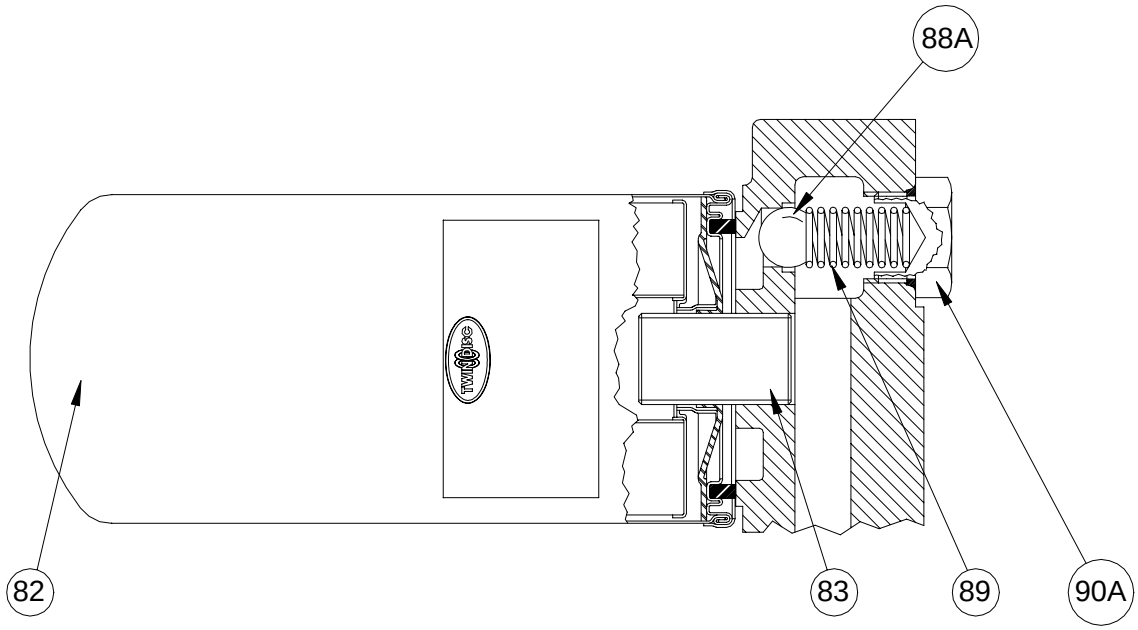
Item	Qty.	Description
44	2	Race, thrust
45	1	O-ring (valve cover)
46	1	Collar, stop
47	1	Pin, roll
48	1	Screw, Socket head
49	1	Lever, shift
50	1	Screw, hex head
51	1	Seal, oil
52	1	Cover, valve
53	1	Gasket (valve cover)
54	1	Spring (detent)
55	1	O-ring
57	1	Plug (optional oil inlet)
58	2	Plug
59	1	Piston (pressure regulating)
60	3	Screw (short) (12pt head or socket head depending on model)
	1	Screw (long) (12pt head or socket head depending on model)
61	1	Spring, outer pressure regulating
62	4	Closure, plastic (valve to manifold screw holes)
63	1	Shim, neutral pressure adjustment
64	1	Spring, inner pressure regulating
65	1	Body, valve
66	1	Spring, check ball
67	1	Ball, steel check
68	2	Gasket, (orifice plate and orifice plate cover use same gasket)
69	1	Cover, orifice plate
70	4	Screw, hex head
71	1	Plate, orifice
72	1	Piston, rate-of-rise
73	AR	Shim, pressure adjustment
74	1	Gasket, valve
75	1	Stem, valve
76	1	Ball, detent
77	1	Bearing, needle thrust

Suction Strainer



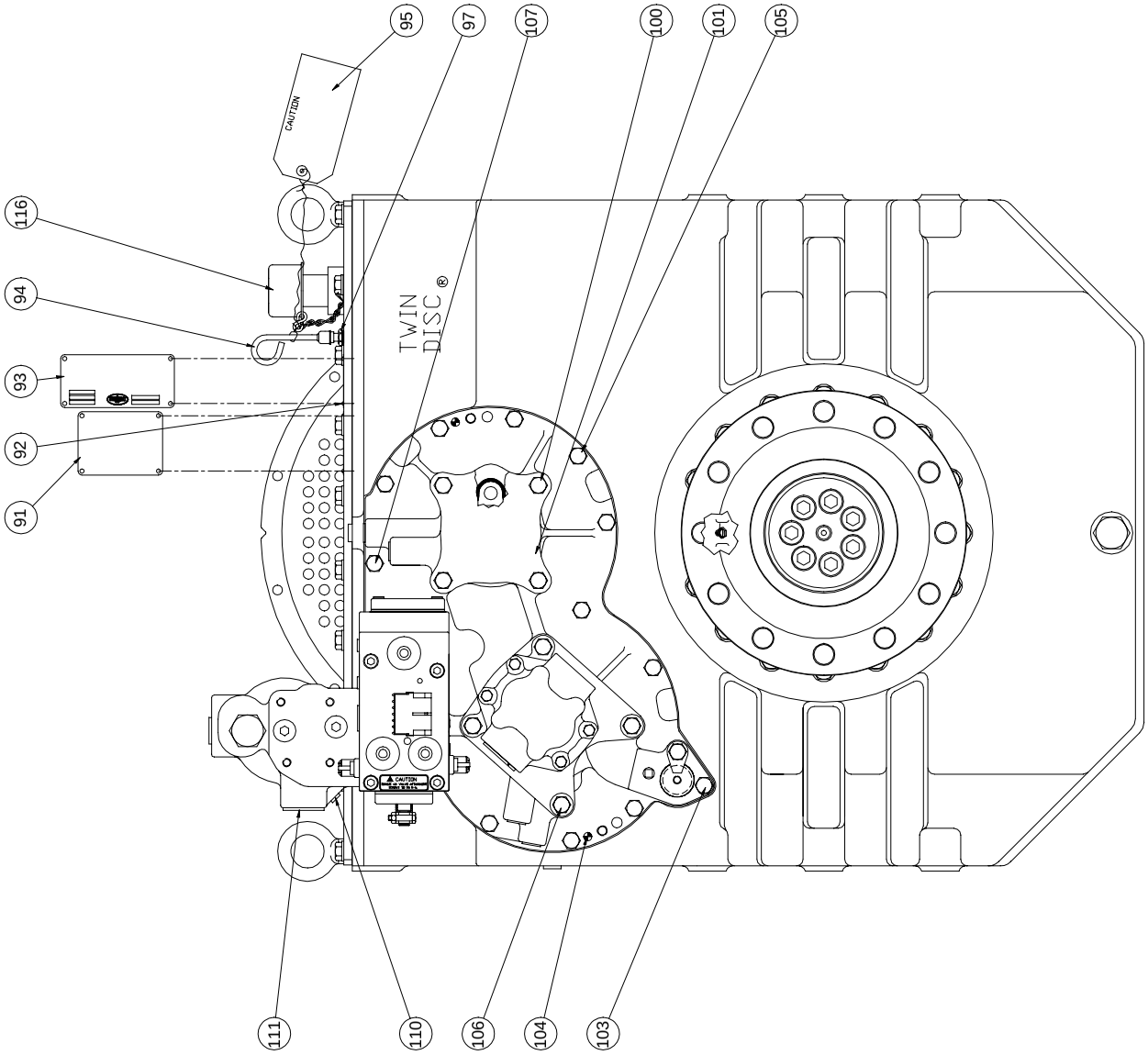
Item	Qty.	Description
78	1	O-ring (suction strainer cover)
79	1	Cover, suction strainer
80	1	Plate, clamp (manifold @ suction strainer cover)
81	1	Strainer, suction

Oil Filter



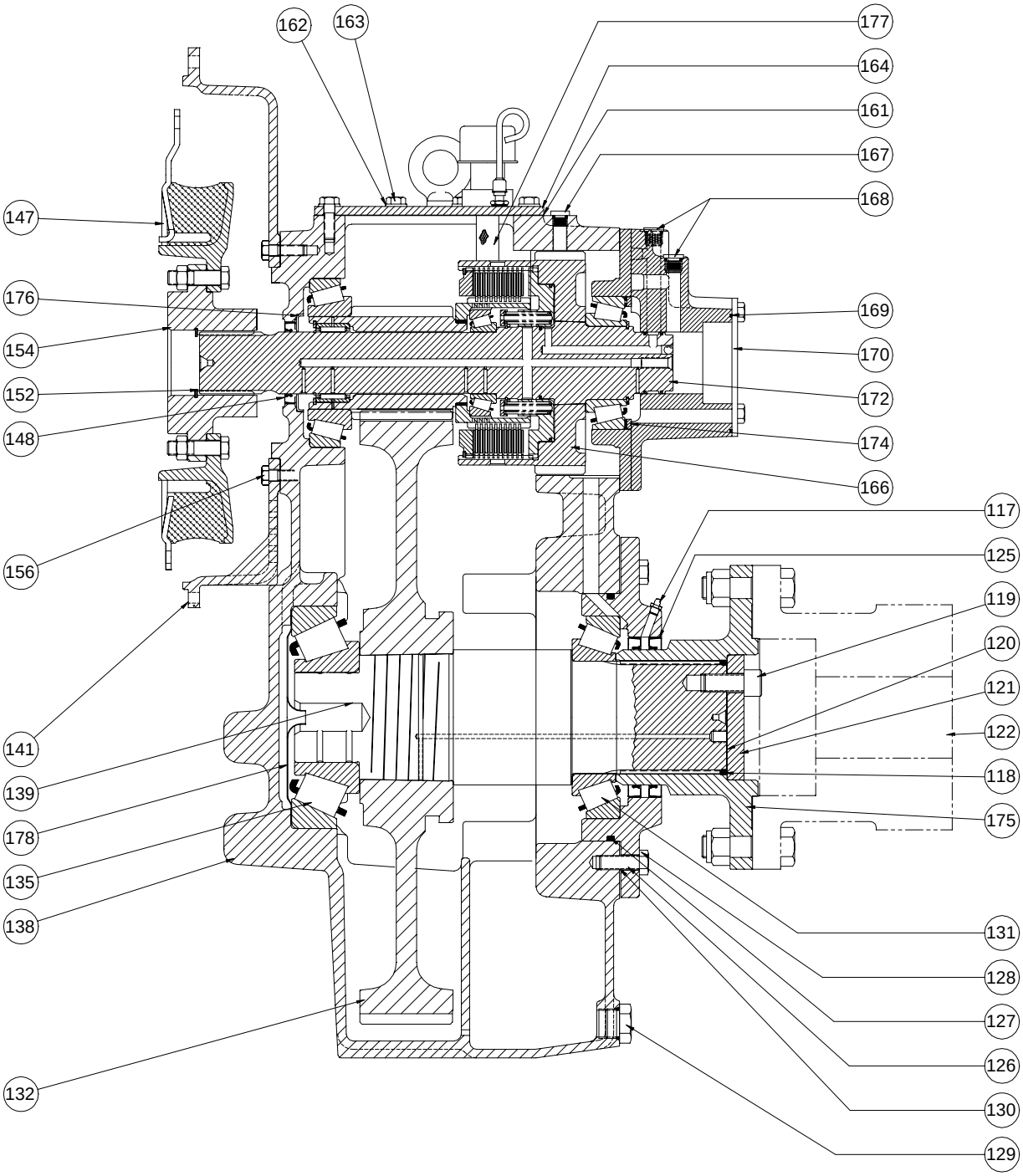
Item	Qty.	Description
82	1	Filter assembly
83	1	Fitting, threaded (filter to manifold)
88A	1	Ball
89	1	Spring (filter bypass valve)
90A	1	Plug

Transmission Rear View



Item	Qty.	Description	Item	Qty.	Description
91	1	Plate, instruction (lube)	103	2	Screw, hex head (manifold and strainer)
92	8	Screw, drive (lube & identification)	104	2	Pin, dowel (manifold)
93	1	Plate, instruction (identification)	105	9	Screw, hex head (manifold)
94	1	Gauge, oil level	106	4	Screw, hex head (pump)
95	1	Tag, oil gauge (wired to gauge)	107	4	Screw, hex head (manifold)
96	1	Plug assembly	110	1	Plug, o-ring (manifold at filter drain)
97	1	Tube assembly, oil gauge	111	1	Closure (manifold inlet)
100	4	Screw, hex head (manifold cover)	116	1	Breather
101	3	Plug, manifold	-	-	-

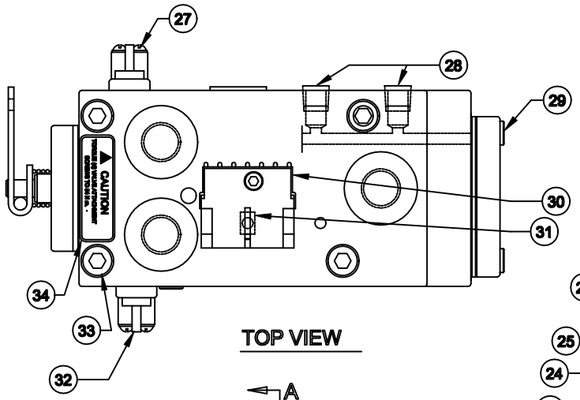
Transmission Section View



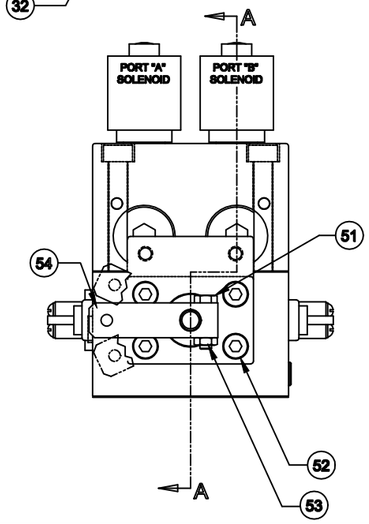
Item	Qty.	Description
117	1	Fitting, grease (output seal carrier)
118	1	O-ring (output flange)
119	7	Screw, socket head (output flange)
120	AR	Shim, output flange retainer
121	1	Washer, retainer (output shaft)
122	1	Flange, companion
125	2	Seal, oil (output flange)
126	1	Carrier, output seal
127	1	O-ring (output seal carrier)
128	15	Screw, hex head (output seal carrier)
129	1	Plug assembly (oil drain)
130	AR	Shim, rear bearing, output shaft
131	1	Bearing, tapered roller (output shaft rear bearing)
132	1	Gear, output
135	1	Bearing, tapered roller (output shaft front bearing)
138	1	Housing assembly
139	1	Shaft, output
141	1	Housing, front
147	1	Coupling, flexible
148	1	Seal, oil (input)
152	1	Ring, internal retaining (input hub)
154	1	Hub, splined
156	12	Screw, hex head (front housing)
161	1	Gasket, top cover
162	24	Washer, flat (top cover)
163	24	Screw, hex head (top cover)
164	1	Cover assembly, top
166	1	Gear, transfer (primary shaft, RH helix)
167	2	Plug assembly (M16x1.5 speed pick-up ports)
168	4	Plug assembly (M18x1.5 pressure test ports)
169	1	O-ring (primary shaft end cover)
170	1	Cover, primary shaft end
172	1	Shaft assembly, primary
174	AR	Shim, bearing (primary and secondary shaft rear bearing)
175	1	Flange, output
176	1	Plug, protection (behind input oil seal)
177	1	Screen, strainer (oil filler)
178	1	Shield, oil distribution

Notes

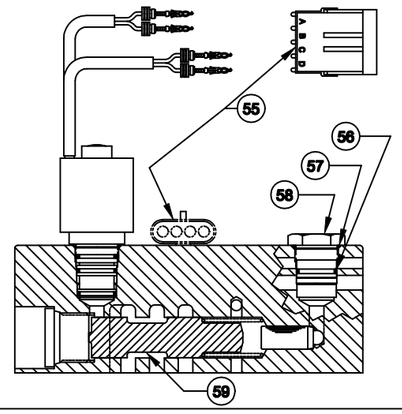
CONTROL VALVE GROUP

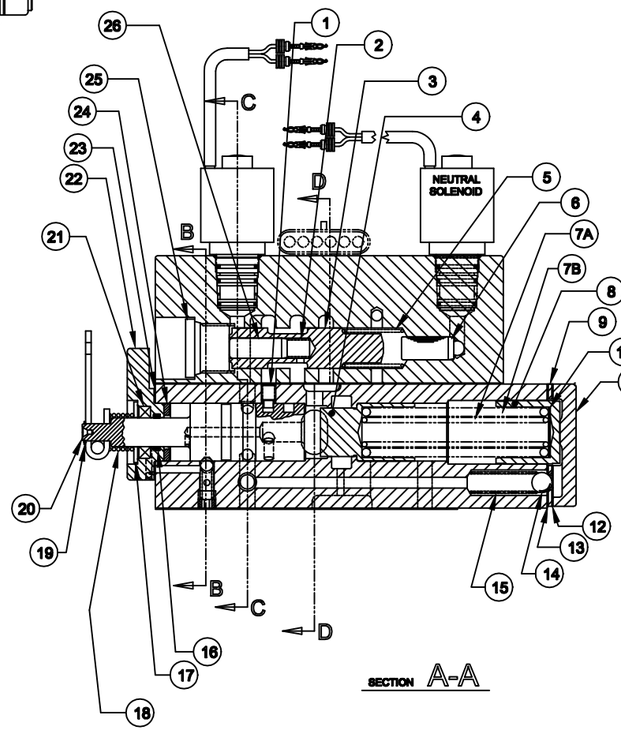


TOP VIEW

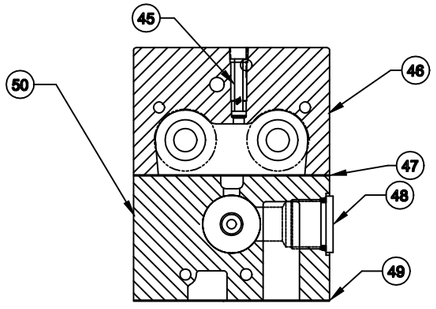


PARTS FOR UNITS WITHOUT NEUTRAL SOLENOID AND HYDRAULIC LOCK (OPTIONAL CONDITION)

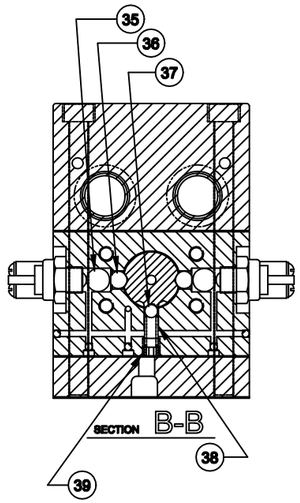


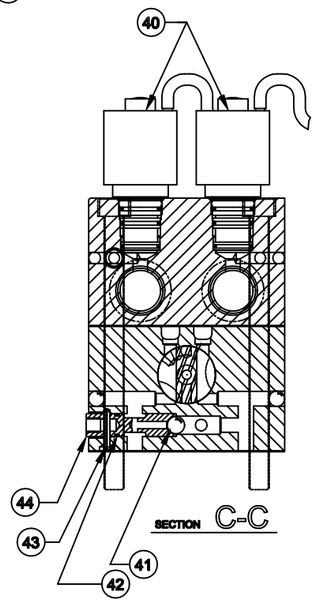


SECTION A-A



SECTION D-D

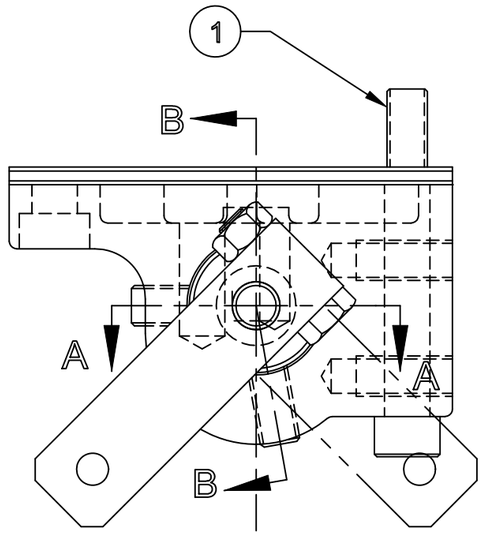


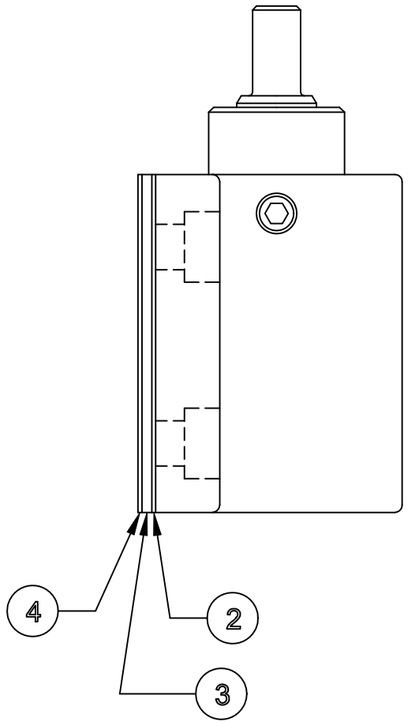


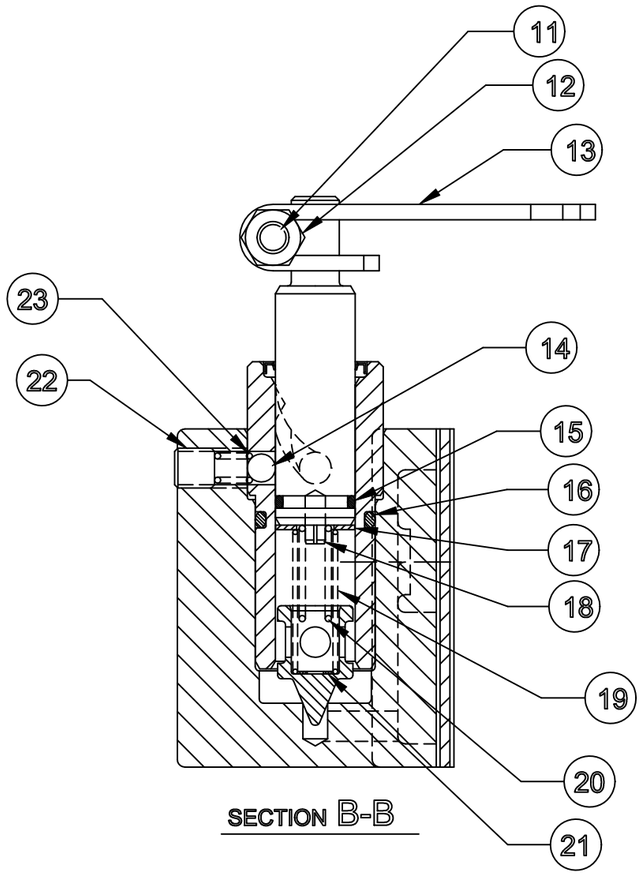
SECTION C-C

ITEM	NAME	Q'TY	REMARKS
1	SETSCREW	1	DOG POINT
2	SPRING	2	UNITS WITH HYD. LOCK
3	SPOOL	2	UNITS WITH HYD. LOCK
4	PISTON	1	
5	SPRING	2	
6	PIN	2	
7a	SPRING	1	INNER (PRESS. REGULATING)
7b	SPRING	1	OUTER (PRESS. REGULATING)
8	PISTON	1	
9	PLATE, ORIFICE	1	
10	SHIM	AS REQ'D	
11	COVER	1	
12	GASKET	1	COVER
13	GASKET	1	ORIFICE PLATE
14	BALL	1	
15	SPRING	1	NEUTRAL PRESS. REGULATING
16	"O" RING	1	
17	WASHER	1	
18	SPRING	1	
19	RING, SNAP	1	
20	STEM	1	
21	SEAL	1	
22	COVER	1	
23	GASKET	1	
24	WASHER	1	
25	PLUG ASSEMBLY	2	
26	PIN	2	UNITS WITH HYD. LOCK
27	SWITCH	1	MANUAL OVERRIDE NEUTRAL START
28	PLUG	2	MAIN PRESSURE PORTS
29	SCREW	4	SOCKET HEAD
30	CONNECTOR, SHROUD	1	UNITS WITH HYD. LOCK
31	CLIP, CONNECTOR	1	
32	SWITCH	1	ELECTRIC CONTROL MODE
33	SCREW	4	SOCKET HEAD
34	PLATE	1	CAUTION
35	BALL	2	LARGE DIA.
36	BALL	2	SMALL DIA.
37	BALL	1	
38	SPRING	1	DETENT
39	SETSCREW	1	
40	SOLENOID	2	3 REQ'D. FOR UNITS WITH HYD. LOCK
41	BALL	1	SHUTTLE
42	"O"RING	1	
43	PIN	1	
44	SEAT	1	
45	SCREEN	1	
46	VALVE BODY	1	
47	GASKET	1	VALVE BODY HALF
48	PLUG ASSEMBLY	1	SOME MODELS
49	GASKET	1	
50	VALVE BODY	1	
51	SCREW	1	HEX. HEAD
52	SCREW	4	SOCKET HEAD
53	NUT	1	
54	LEVER	1	
55	CONNECTOR, SHROUD	1	UNITS WITHOUT HYD. LOCK
56	"O" RING	1	UNITS WITHOUT HYD. LOCK
57	"O" RING	1	UNITS WITHOUT HYD. LOCK
58	PLUG	1	UNITS WITHOUT HYD. LOCK
59	SPOOL	2	UNITS WITHOUT HYD. LOCK

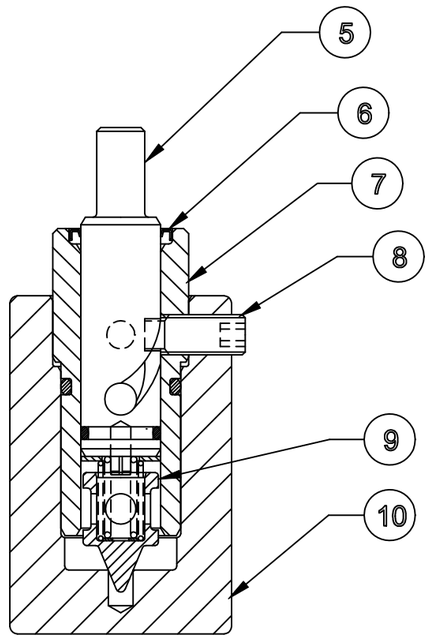
Notes







SECTION B-B



SECTION A-A

TROLLING VALVE GROUP

ITEM	N A M E	Q'TY	REMARKS
1	SCREW	2	SOCKET HEAD
2	GASKET	1	BODY
3	PLATE, ORIFICE	1	
4	GASKET	1	PLATE
5	STEM	1	
6	SEAL	1	
7	ADAPTER	1	
8	SETSCREW	1	DOG POINT
9	PISTON	1	
10	VALVE BODY	1	
11	SCREW	1	HEX. HEAD
12	NUT	1	
13	LEVER	1	
14	BALL	1	
15	"O" RING	1	
16	"O" RING	1	
17	WASHER	1	SOME MODELS
18	PIN	1	
19	SPRING	1	OUTER
20	SPRING	1	INNER
21	WASHER	1	SOME MODELS
22	SETSCREW	1	
23	SPRING	1	DETENT

Notes

Engineering Drawings

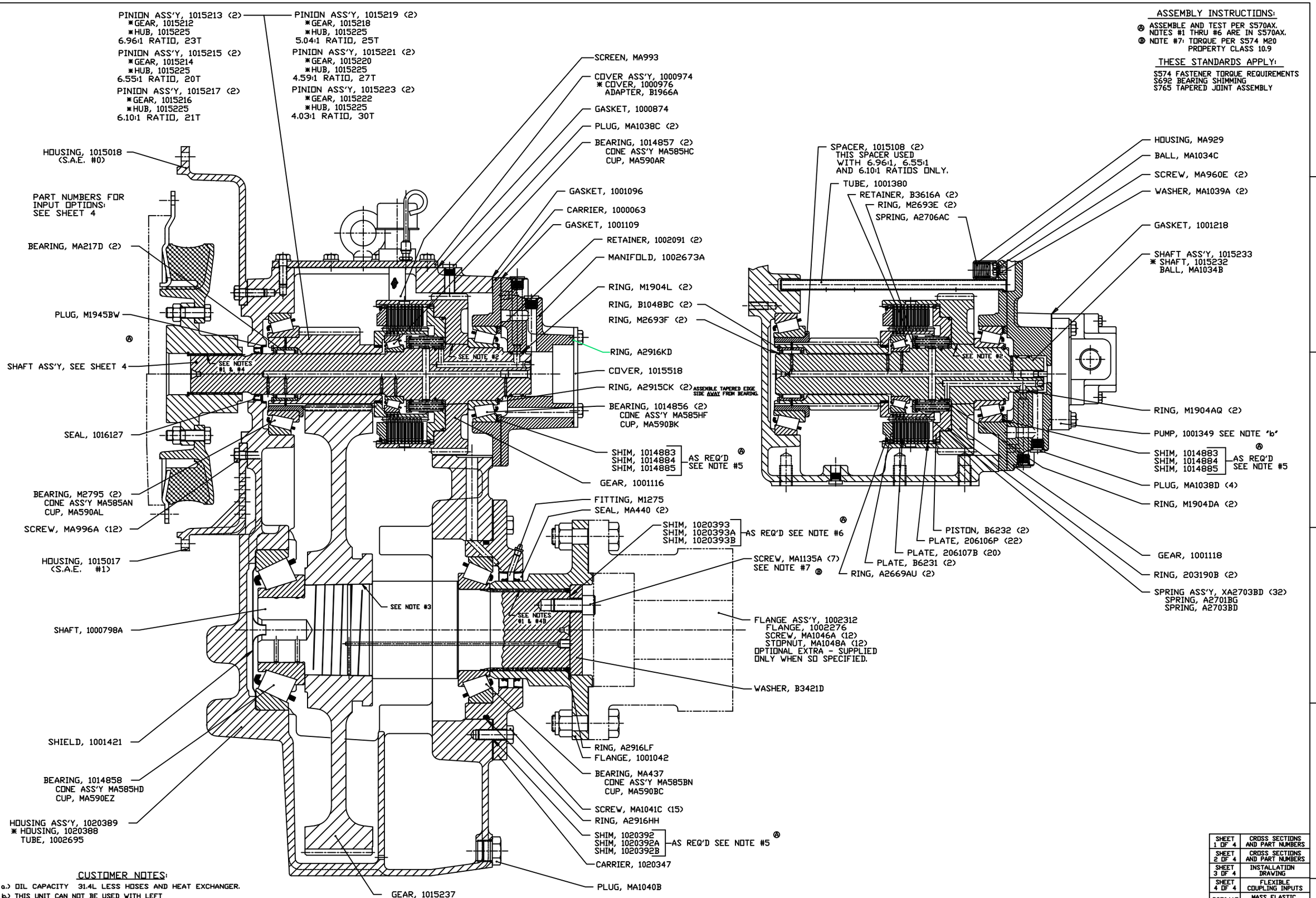
List of Engineering Drawings

The following pages include the engineering drawings that are specific to this model. The engineering drawings included are listed below.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

- ❑ 1020391 Sheet 1 of 4: Cross Section
- ❑ 1020391 Sheet 2 of 4: Cross Section (con't)
- ❑ 1020391 Sheet 3 of 4: Installation Drawing
- ❑ 1020391 Sheet 4 of 4: Input Couplings
- ❑ A7119R Transmission Hydraulic Diagram
- ❑ 1020412 Mechanical Control Valve (Without Trolling)
- ❑ 1020413 Mechanical Control Valve (With Trolling)
- ❑ 1018084 Optional Electric Control Valve (Without Trolling)
- ❑ 1018085 Optional Electric Control Valve (With Electric Trolling)
- ❑ 1018440 Optional Electric Control Valve (With Manual Trolling)
- ❑ 1018883 Electric Trolling Valve Kit (Rotated 90°)
- ❑ 1017555 Manual Trolling Valve Kit for 1018084
- ❑ A7119W Sheet 1 of 3: Optional Electric Control Valve Hydraulic Diagram. (Without trolling)
- ❑ A7119W Sheet 2 of 3: Optional Electric Control Valve Hydraulic Diagram. (With electric trolling)

- ❑ A7119W Sheet 3 of 3: Optional Electric Control Valve Hydraulic Diagram. (With manual trolling)
- ❑ 1016473 Pump Assembly (Trailing)



ASSEMBLY INSTRUCTIONS:

Ⓐ ASSEMBLE AND TEST PER S570AX. NOTES #1 THRU #6 ARE IN S570AX.

Ⓑ NOTE #7: TORQUE PER S574 M20 PROPERTY CLASS 10.9

THESE STANDARDS APPLY:

S574 FASTENER TORQUE REQUIREMENTS
S692 BEARING SHIMMING
S765 TAPERED JOINT ASSEMBLY

CUSTOMER NOTES:

a.) OIL CAPACITY 31.4L LESS HOSES AND HEAT EXCHANGER.

b.) THIS UNIT CAN NOT BE USED WITH LEFT HAND ENGINE.

c.) OPTIONAL EQUIPMENT:
COMPANION FLANGE ASSEMBLY: 1002312
MECHANICAL TROLL: K1331 (USE ON 1020412 VALVE ONLY)
MECHANICAL TROLL: 1017555 (USE ON 1018084 VALVE ONLY)
ELECTRICAL TROLL: 1017554 (USE ON 1018084 VALVE ONLY)
LIVE P.T.O.: 1017177 (AUXILIARY PUMP DRIVE)
HYDRAULIC CLUTCHED P.T.O.: 1017820
TRAILING PUMP: 1016473
FLEXIBLE COUPLING INPUTS-SEE SHEET 4 OF 4.
METRIC TO N.P.T.F. ADAPTER KIT: K1090
OIL TEMPERATURE INDICATING SWITCH: B3424, FOR INSTALLATION LOCATION, SEE HYDRAULIC DIAGRAM AND SHEET 3.
REMOTE FILTER KIT - 1019824 - K1296

* NOT SERVICEABLE SEPARATELY.

▲ REMOVE BEFORE OPERATING, 2 PLACES, PLUGS.

GEAR RATIOS:

4.03:1	6.09:1
4.59:1	6.55:1
5.04:1	6.96:1

SHEET 1 OF 4	CROSS SECTIONS AND PART NUMBERS
SHEET 2 OF 4	CROSS SECTIONS AND PART NUMBERS
SHEET 3 OF 4	INSTALLATION DRAWING
SHEET 4 OF 4	FLEXIBLE COUPLING INPUTS
B3504AF	MASS ELASTIC SYSTEM
B3649K	HEAT EXCHANGER REQUIREMENTS
A7119R	HYDRAULIC DIAGRAM

MAX. INPUT SPEED: 2500 R.P.M. CONSULT SALES DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

1	B	6-3	ECN10577	12-19-01	
1&4	A		ECN10354	8-27-01	
SHTS AFFD	REV	ZONE	CH. NO.	DATE	

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MATERIAL	
HEAT TREAT	
SURFACE TREATMENT	
WEIGHT	1046 kg
FIRST USE	
ASSY. MODEL	
NAME	MG-5222DC MARINE TRANSMISSION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS: .X ±0.25; .XX ±0.05; .XXX ±0.13
ALL ANGULAR TOLERANCES AND BENDING TOLERANCES PER ANSI Y14.5M 1982

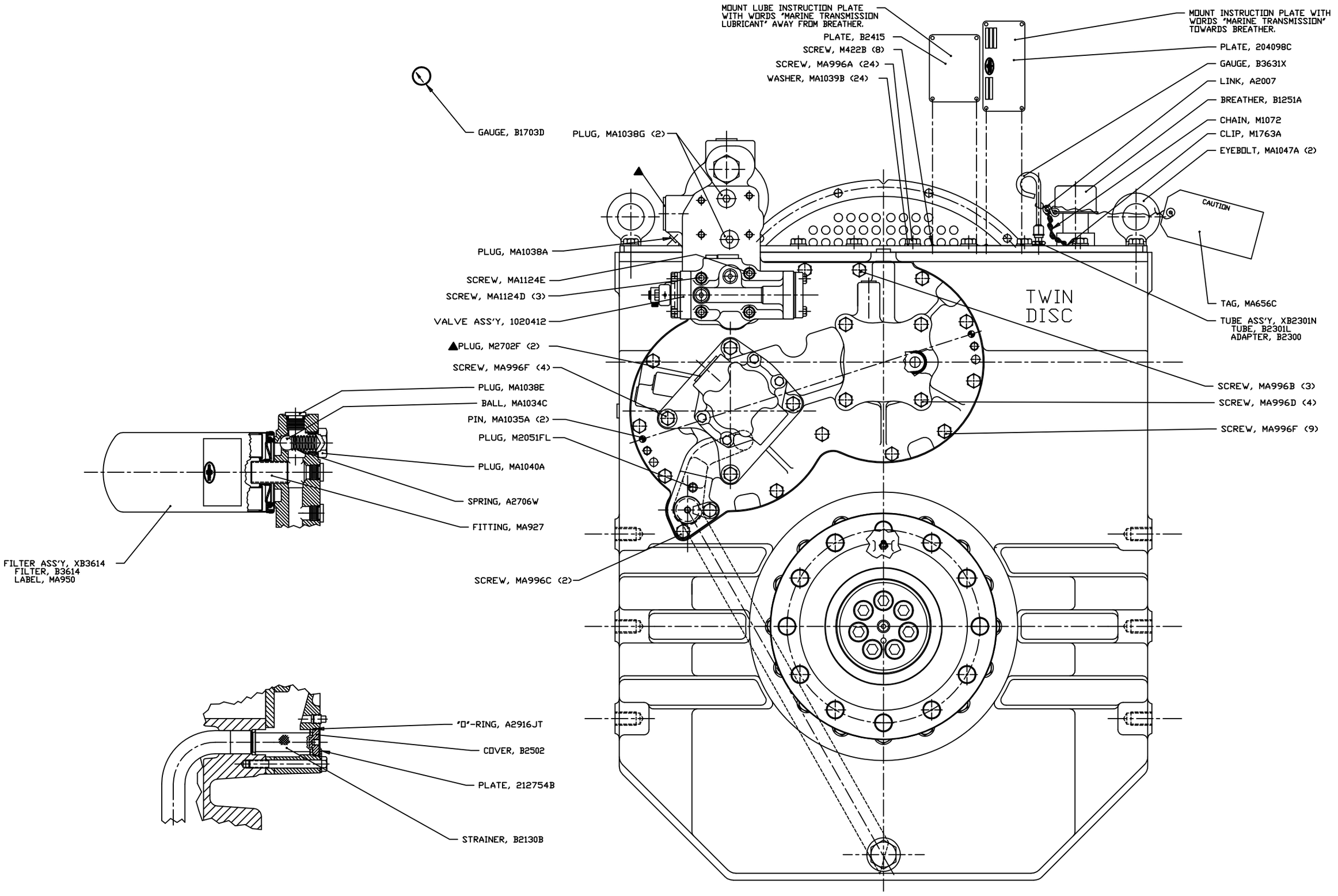
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

DATE	8-3-01
SCALE	.50=1.00
DRN.	J.R.
CHK.	ALC
APPD.	GAM

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020391

SHEET 1 OF 4 REV B



METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 1046 kg

FIRST USE

ASSY.

MODEL

NAME MG-5222DC MARINE TRANSMISSION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
XX ±0.25
XXX ±0.13
ALL ANGULAR TOLERANCES AND GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 8-3-01
SCALE .50=1.00
DRN. J.R.
CHK. ALC
APPR. GAM

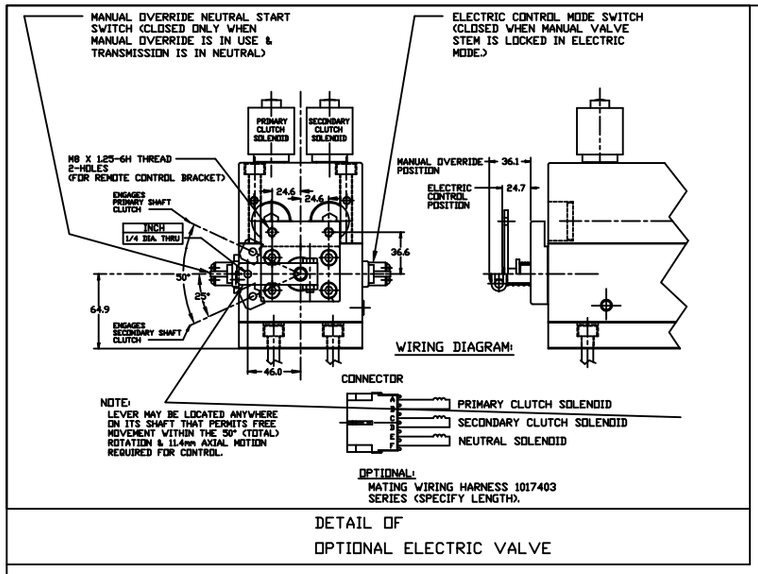
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020391

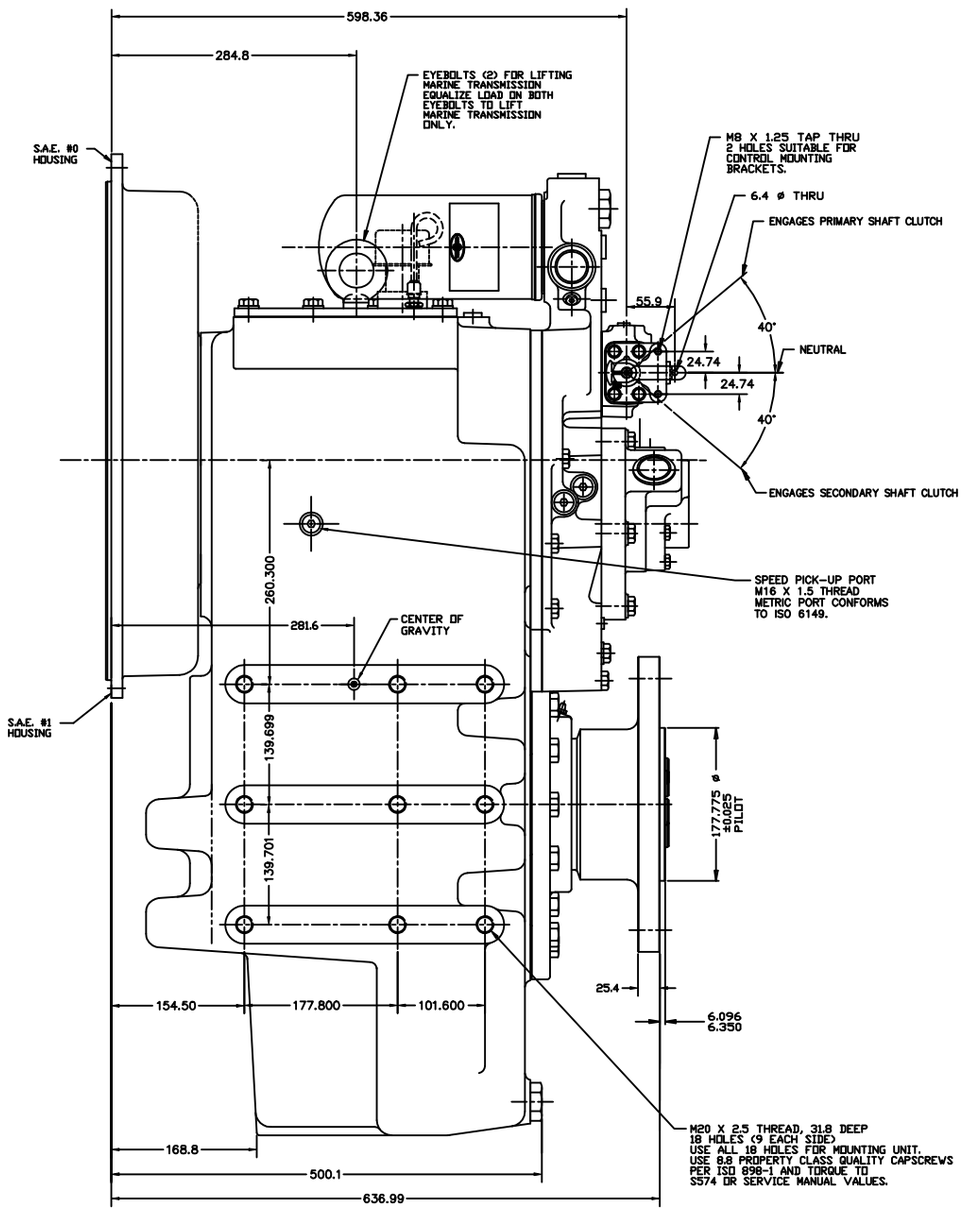
SHEET 2 OF 4 REV B

E D C B A

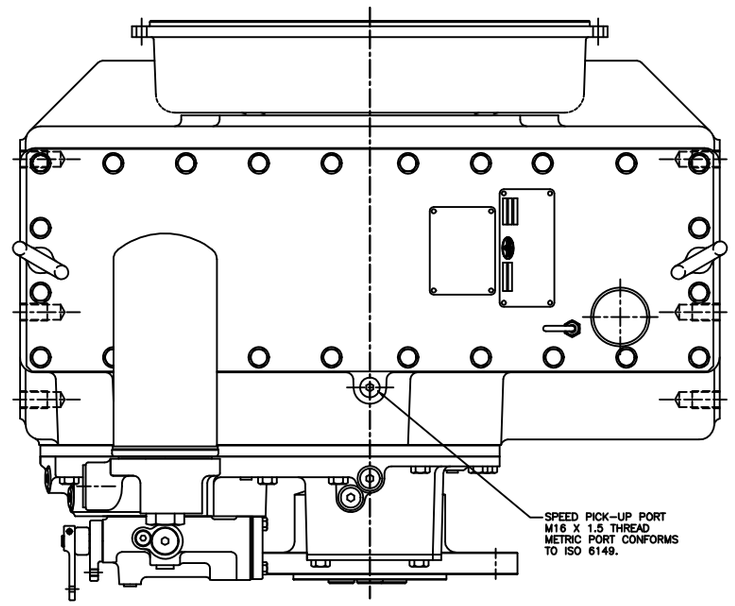
1 2 3 4 5 6

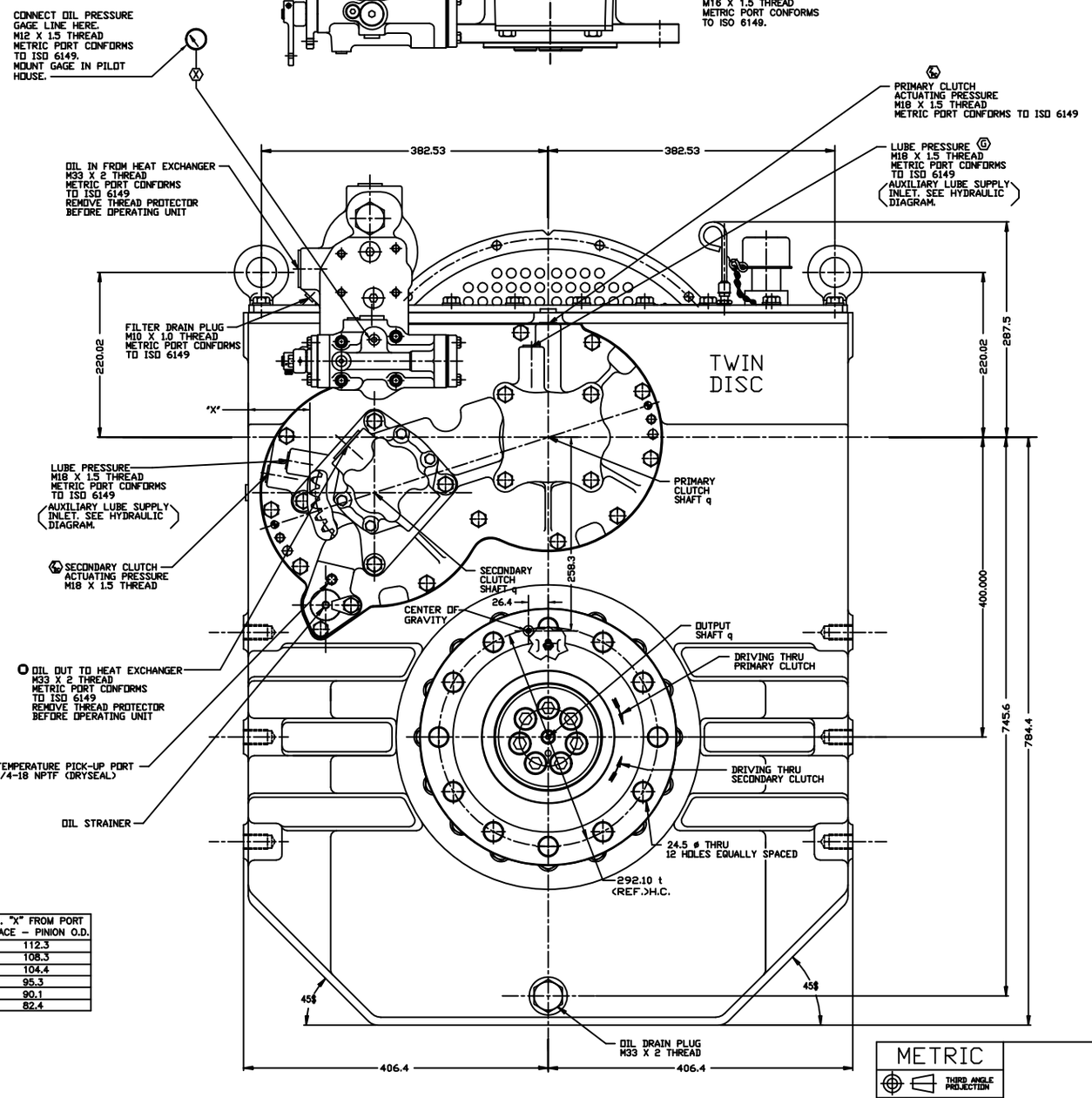

MANUAL OVERRIDE NEUTRAL START SWITCH (CLOSED ONLY WHEN MANUAL OVERRIDE IS IN USE & TRANSMISSION IS IN NEUTRAL)
ELECTRIC CONTROL MODE SWITCH (CLOSED WHEN MANUAL VALVE STEM IS LOCKED IN ELECTRIC MODE.)
PRIMARY CLUTCH SOLENOID
SECONDARY CLUTCH SOLENOID
M8 X 1.25-6H THREAD 2-HOLES (FOR REMOTE CONTROL BRACKET)
ENGAGES PRIMARY SHAFT CLUTCH
INCH 1/4 DIA. THRU
MANUAL OVERRIDE POSITION
ELECTRIC CONTROL POSITION
36.1
24.7
24.6
24.6
36.6
50°
25°
64.9
ENGAGES SECONDARY SHAFT CLUTCH
46.0
WIRING DIAGRAM:
CONNECTOR
PRIMARY CLUTCH SOLENOID
SECONDARY CLUTCH SOLENOID
NEUTRAL SOLENOID
NOTE: LEVER MAY BE LOCATED ANYWHERE ON ITS SHAFT THAT PERMITS FREE MOVEMENT WITHIN THE 50° (TOTAL) ROTATION & 11.4mm AXIAL MOTION REQUIRED FOR CONTROL.
OPTIONAL: MATING WIRING HARNESS 1017403 SERIES (SPECIFY LENGTH).

DETAIL OF
OPTIONAL ELECTRIC VALVE



TRANSFER GEAR	GEAR SETS	DIM. "X" FROM PORT S'FACE – PINION O.D.
40.5	6.96:1	112.3
	6.55:1	108.3
	6.10:1	104.4
	5.04:1	95.3
	4.59:1	90.1
	4.03:1	82.4




CONNECT OIL PRESSURE GAGE LINE HERE. M12 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149. MOUNT GAGE IN PILOT HOUSE.
PRIMARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
382.53
382.53
OIL IN FROM HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE THREAD PROTECTOR BEFORE OPERATING UNIT
LUBE PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
FILTER DRAIN PLUG M10 X 1.0 THREAD METRIC PORT CONFORMS TO ISO 6149
220.02
"X"
TWIN DISC
287.5
220.02
LUBE PRESSURE M18 X 1.5 THREAD METRIC PORT CONFORMS TO ISO 6149
AUXILIARY LUBE SUPPLY INLET. SEE HYDRAULIC DIAGRAM.
PRIMARY CLUTCH SHAFT q
SECONDARY CLUTCH ACTUATING PRESSURE M18 X 1.5 THREAD
SECONDARY CLUTCH SHAFT q
258.3
26.4
CENTER OF GRAVITY
OUTPUT SHAFT q
DRIVING THRU PRIMARY CLUTCH
400.000
OIL OUT TO HEAT EXCHANGER M33 X 2 THREAD METRIC PORT CONFORMS TO ISO 6149 REMOVE THREAD PROTECTOR BEFORE OPERATING UNIT
TEMPERATURE PICK-UP PORT 1/4-18 NPTF (DRYSEAL)
OIL STRAINER
DRIVING THRU SECONDARY CLUTCH
745.6
784.4
24.5 ø THRU 12 HOLES EQUALLY SPACED
292.10 t (REF.)D.H.C.
45$
45$
OIL DRAIN PLUG M33 X 2 THREAD
406.4
406.4

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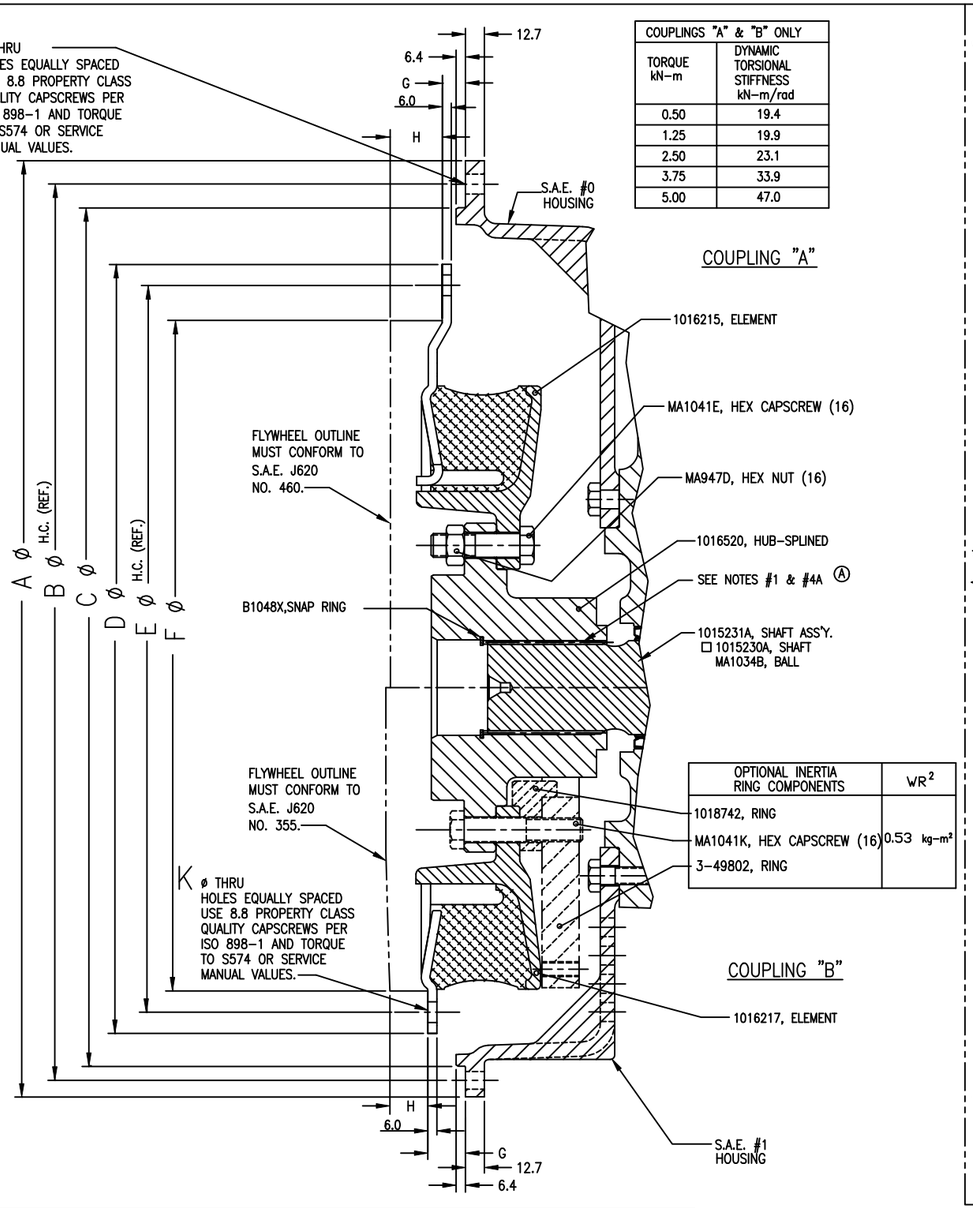
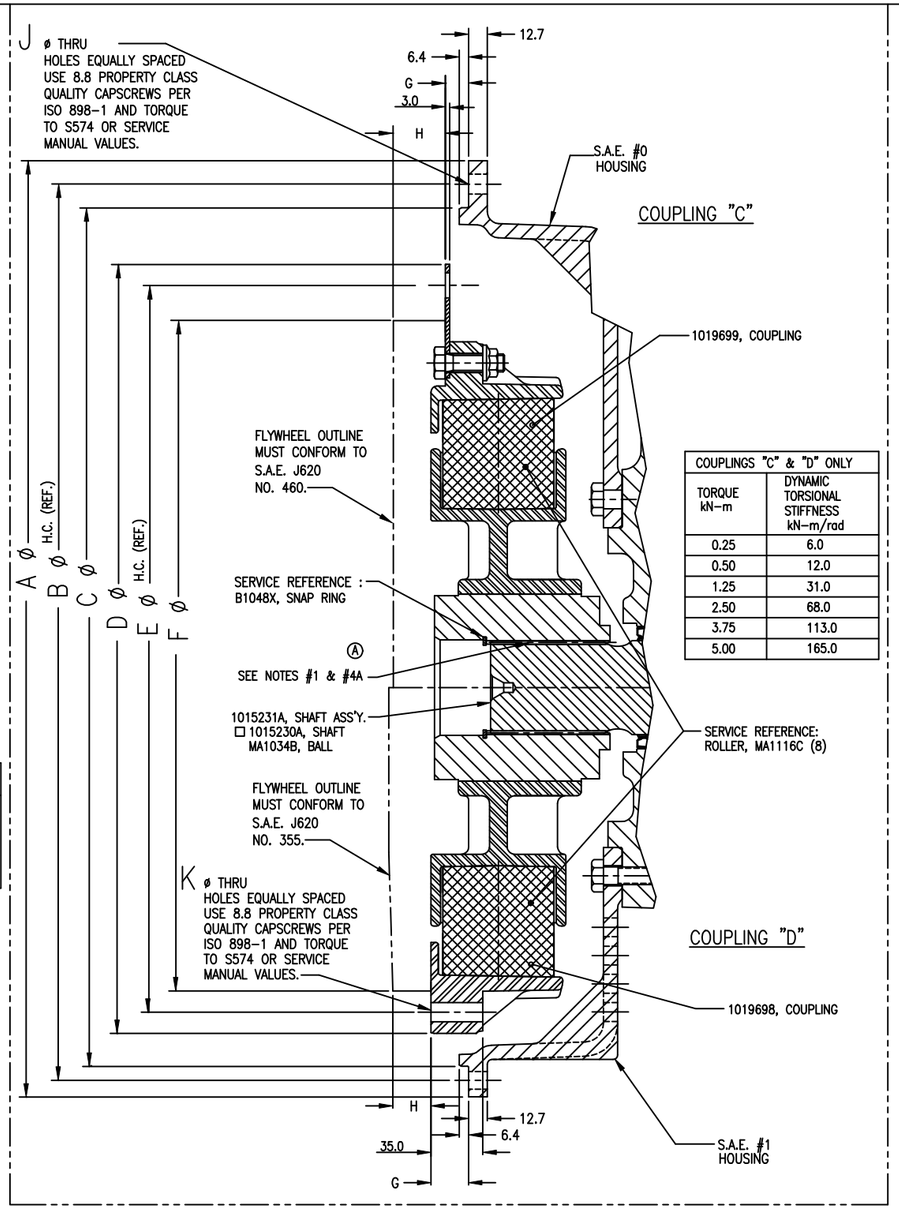
	HEAT TREAT	FIRST USE		SCALE .375=1.00			
		ASSY.	ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DRN. J.R.			
	SURFACE TREATMENT	MODEL		CHK. AL.C	1020391		
		NAME MG-5222DC MARINE TRANSMISSION		APPD. GAM	SHEET 3 OF 4	REV B	

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

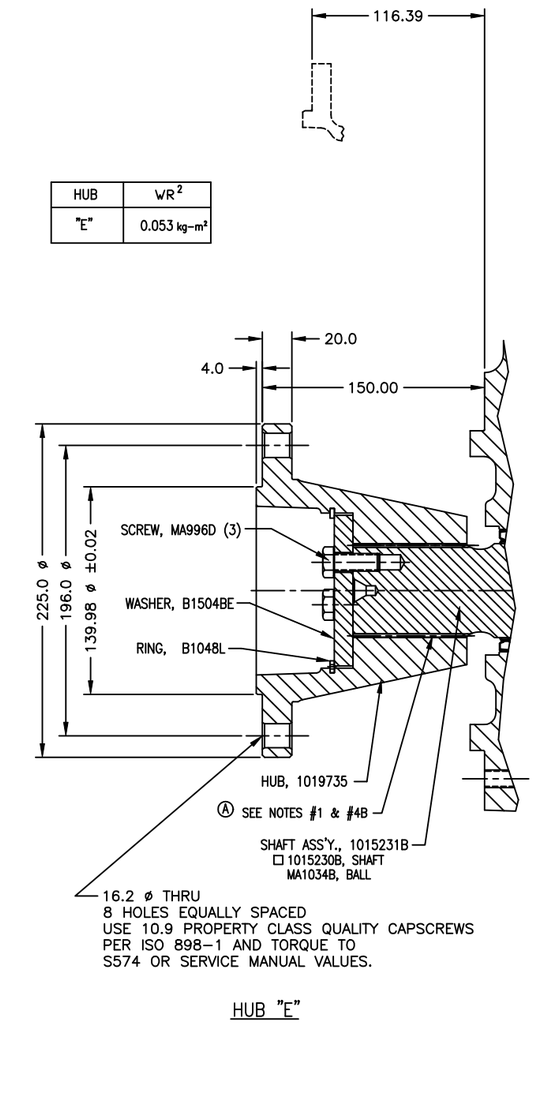
E D C B A



COUPLINGS "A" & "B" ONLY	
TORQUE kN-m	DYNAMIC TORSIONAL STIFFNESS kN-m/rad
0.50	19.4
1.25	19.9
2.50	23.1
3.75	33.9
5.00	47.0



COUPLINGS "C" & "D" ONLY	
TORQUE kN-m	DYNAMIC TORSIONAL STIFFNESS kN-m/rad
0.25	6.0
0.50	12.0
1.25	31.0
2.50	68.0
3.75	113.0
5.00	165.0



HUB	WR²
"E"	0.053 kg-m²

COUPLING	SAE J620 FLYWHEEL SIZE	COUPLING NO.	MAX. COUPLING rpm*	NOMINAL TORQUE kN-m	DYNAMIC TORSIONAL STIFFNESS	COUPLING WR² kg-m² OUTER PARTS	COUPLING WR² kg-m² INNER PARTS **
A	NO. 460	VKE 4911S -4000/18	2750	5.00	PER CHART	0.61	0.41
B	NO. 355	VKE 4911S -4000/14	2750	5.00	PER CHART	0.24	0.41
C	NO. 460	CF-R-308-018 -60014-HR	2800	5.00	PER CHART	0.290	0.166
D	NO. 355	CF-R-308-014 -60013-HR	3000	5.00	PER CHART	0.206	0.166

SAE NO	S.A.E. J620 MARINE TRANSMISSION FLYWHEEL NO.	A	B	C +0.000 -0.127	D +0.00 -0.13	E	F	G	H	J	K
0	460	711.2	679.45	647.70	571.5	542.9	494	15.7	35.0	16 OF 13.5	6 OF 17
1	355	552.4	530.20	511.17	467.7	438.15	406	25.4	25.7	12 OF 11.9	8 OF 14

* SEE SHEET 1 FOR MAXIMUM TRANSMISSION R.P.M.
** THE WR² OF INNER PARTS INCLUDES HUB AND 1/4 SHAFT C².

☐ NOT SERVICEABLE SEPARATELY

ALL COUPLINGS ABOVE HAVE TORSIONAL STOP INCLUDED.

△ FOR TRANSMISSION SHIPMENT: SECURE FLEXIBLE COUPLING TO HOUSING S.A.E FLANGE HOLES, USING STANDARD METHOD, BEFORE SHIPMENT OF UNIT.

FOR TRANSMISSION/COUPLING ASSEMBLY TO ENGINE:
INSTALL COUPLING AND HUB TO ENGINE FLYWHEEL.
ADVANCE MARINE TRANSMISSION INTO POSITION WITH ENGINE FLYWHEEL HOUSING MOUNTING FLANGE. LINE UP INPUT SHAFT EXTERNAL SPLINE WITH INTERNAL SPLINE IN COUPLING HUB AND MOVE ENGINE AND MARINE TRANSMISSION TOGETHER MAINTAINING ENGINE FLYWHEEL HOUSING AND MARINE TRANSMISSION FLYWHEEL HOUSING MOUNTING FACES IN PARALLEL RELATIONSHIP. ENGAGE FLYWHEEL HOUSING PILOTS AND INSTALL ALL MOUNTING CAPSCREWS USING 8.8 PROPERTY CLASS QUALITY PER ISO 898-1 [GRADE 5 QUALITY CAPSCREWS PER S.A.E. J429] TORQUED TO S574 OR SERVICE MANUAL VALUES.

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

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TWIN DISC, INCORPORATED
RACINE, WI 53403 - USA
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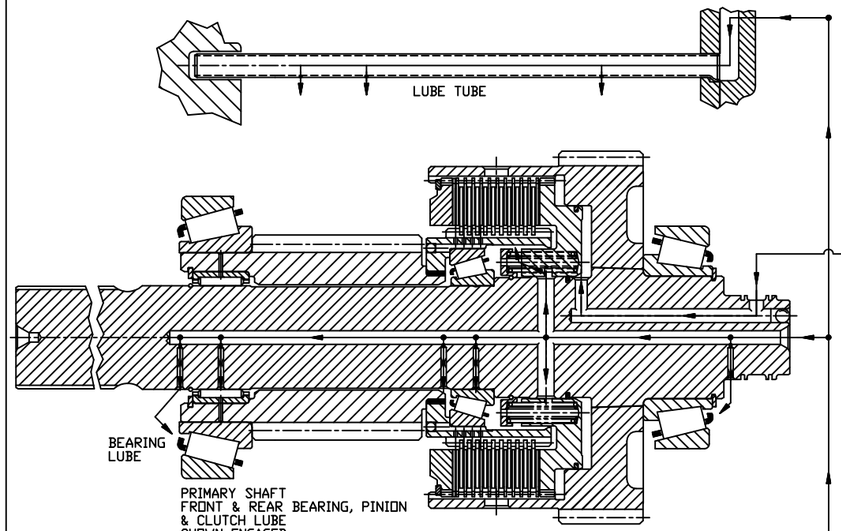
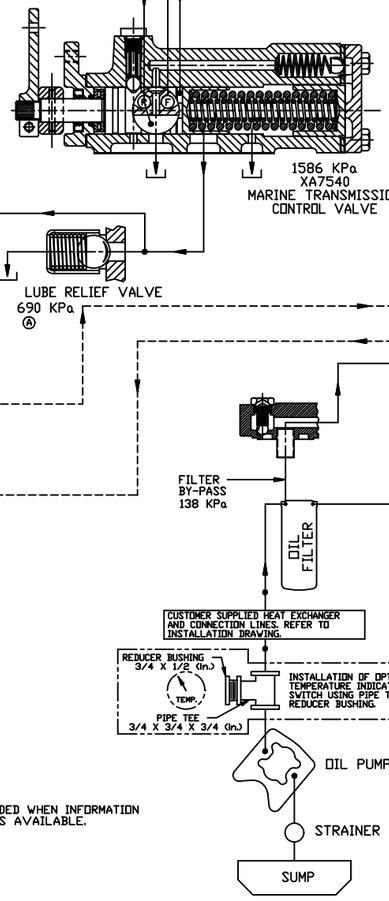
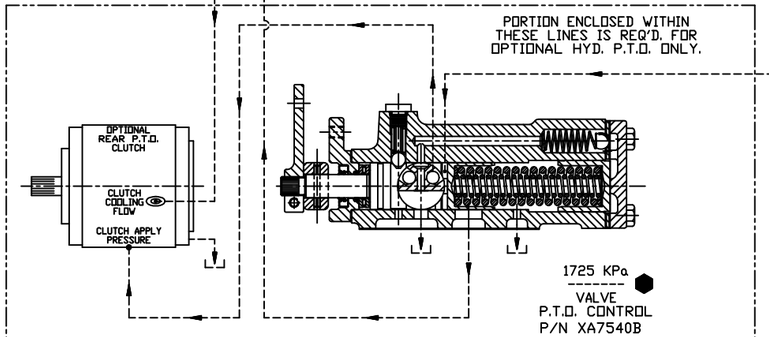
MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT 1046 kg
WR² N m²
FIRST USE
ASSY.
MODEL
NAME MG-5222DC MARINE TRANSMISSION (FLEXIBLE COUPLING INPUTS)
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ANG
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 8-3-01
SCALE .50=1.00
DRN. J.R.
CHK. ALC
APPD. GAM
TWIN DISC INCORPORATED RACINE, WI 53403 - USA
1020391
SHEET 4 OF 4
REV B

F E C B A

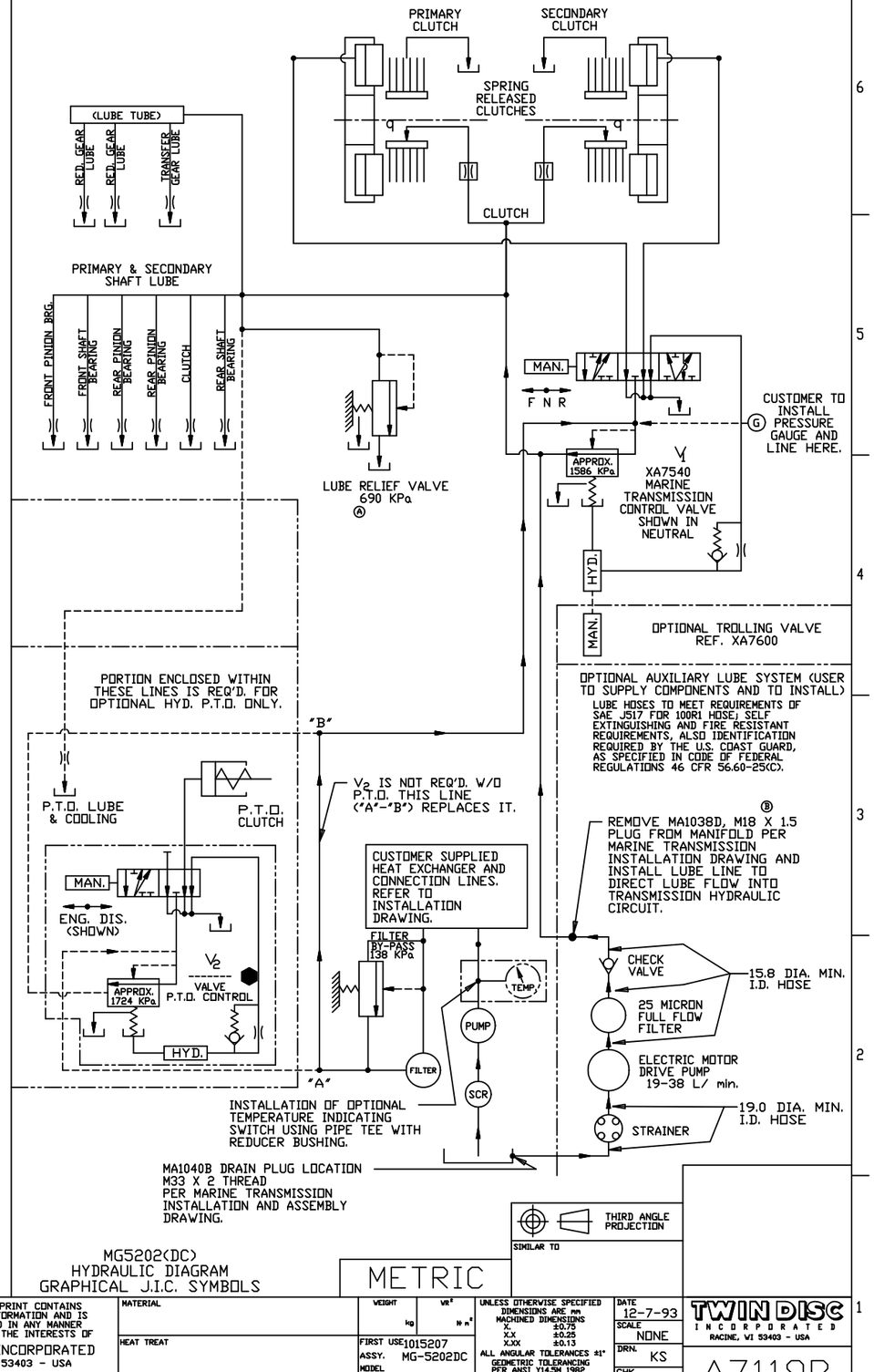

LUBE TUBE
BEARING LUBE
PRIMARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN ENGAGED
SECONDARY SHAFT FRONT & REAR BEARING, PINION & CLUTCH LUBE SHOWN DISENGAGED


G CUSTOMER TO INSTALL PRESSURE GAUGE LINE HERE. PRESSURE GAUGE TO BE MOUNTED IN PILOT HOUSE. (SEE MARINE TRANSMISSION INSTALLATION DRAWING.)
1586 KPa XA7540 MARINE TRANSMISSION CONTROL VALVE
OPTIONAL TROLLING VALVE REF. XA7600 AND XA7601
LUBE RELIEF VALVE 690 KPa
Ⓐ
FILTER BY-PASS 138 KPa
OIL FILTER
CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES. REFER TO INSTALLATION DRAWING.
REDUCER BUSHING 3/4 X 1/2 (in.)
TEMP.
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHING.
PIPE TEE 3/4 X 3/4 X 3/4 (in.)
OIL PUMP
STRAINER
SUMP



● TO BE ADDED WHEN INFORMATION IS AVAILABLE.

MG5202(DC)
HYDRAULIC DIAGRAM
PICTORIAL


PRIMARY CLUTCH
SECONDARY CLUTCH
SPRING RELEASED CLUTCHES
CLUTCH
(LUBE TUBE)
RED. GEAR LUBE
RED. GEAR LUBE
TRANSFER GEAR LUBE
PRIMARY & SECONDARY SHAFT LUBE
FRONT PINION BRG.
FRONT SHAFT BEARING
REAR PINION BEARING
REAR PINION BEARING
CLUTCH
REAR SHAFT BEARING
LUBE RELIEF VALVE 690 KPa
Ⓐ
MAN.
F N R
G CUSTOMER TO INSTALL PRESSURE GAUGE AND LINE HERE.
APPROX. 1586 KPa
XA7540 MARINE TRANSMISSION CONTROL VALVE SHOWN IN NEUTRAL
HYD.
MAN.
OPTIONAL TROLLING VALVE REF. XA7600
OPTIONAL AUXILIARY LUBE SYSTEM (USER TO SUPPLY COMPONENTS AND TO INSTALL)
LUBE HOSES TO MEET REQUIREMENTS OF SAE J517 FOR 100R1 HOSE; SELF EXTINGUISHING AND FIRE RESISTANT REQUIREMENTS, ALSO IDENTIFICATION REQUIRED BY THE U.S. COAST GUARD, AS SPECIFIED IN CODE OF FEDERAL REGULATIONS 46 CFR 56.60-25(c).
PORTION ENCLOSED WITHIN THESE LINES IS REQ'D. FOR OPTIONAL HYD. P.T.O. ONLY.
"B"
P.T.O. LUBE & COOLING
P.T.O. CLUTCH
V2 IS NOT REQ'D. W/O P.T.O. THIS LINE ("A"-"B") REPLACES IT.
Ⓑ
REMOVE MA1038D, M18 X 1.5 PLUG FROM MANIFOLD PER MARINE TRANSMISSION INSTALLATION DRAWING AND INSTALL LUBE LINE TO DIRECT LUBE FLOW INTO TRANSMISSION HYDRAULIC CIRCUIT.
MAN.
ENG. DIS. (SHOWN)
V2
APPROX. 1724 KPa
VALVE
P.T.O. CONTROL
HYD.
CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES. REFER TO INSTALLATION DRAWING.
FILTER BY-PASS 138 KPa
TEMP.
PUMP
FILTER
SCR
"A"
CHECK VALVE
15.8 DIA. MIN. I.D. HOSE
25 MICRON FULL FLOW FILTER
ELECTRIC MOTOR DRIVE PUMP 19-38 L/ min.
STRAINER
19.0 DIA. MIN. I.D. HOSE
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHING.
MA1040B DRAIN PLUG LOCATION M33 X 2 THREAD PER MARINE TRANSMISSION INSTALLATION AND ASSEMBLY DRAWING.

MG5202(DC)
HYDRAULIC DIAGRAM
GRAPHICAL J.I.C. SYMBOLS

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
B	A-3	29222	3-29-99				
A	D-3	29090	1-25-99				

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MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg | WR² lb ft²
FIRST USE 1015207
ASSY. MG-5202DC
MODEL
NAME DIAGRAM, HYDRAULIC

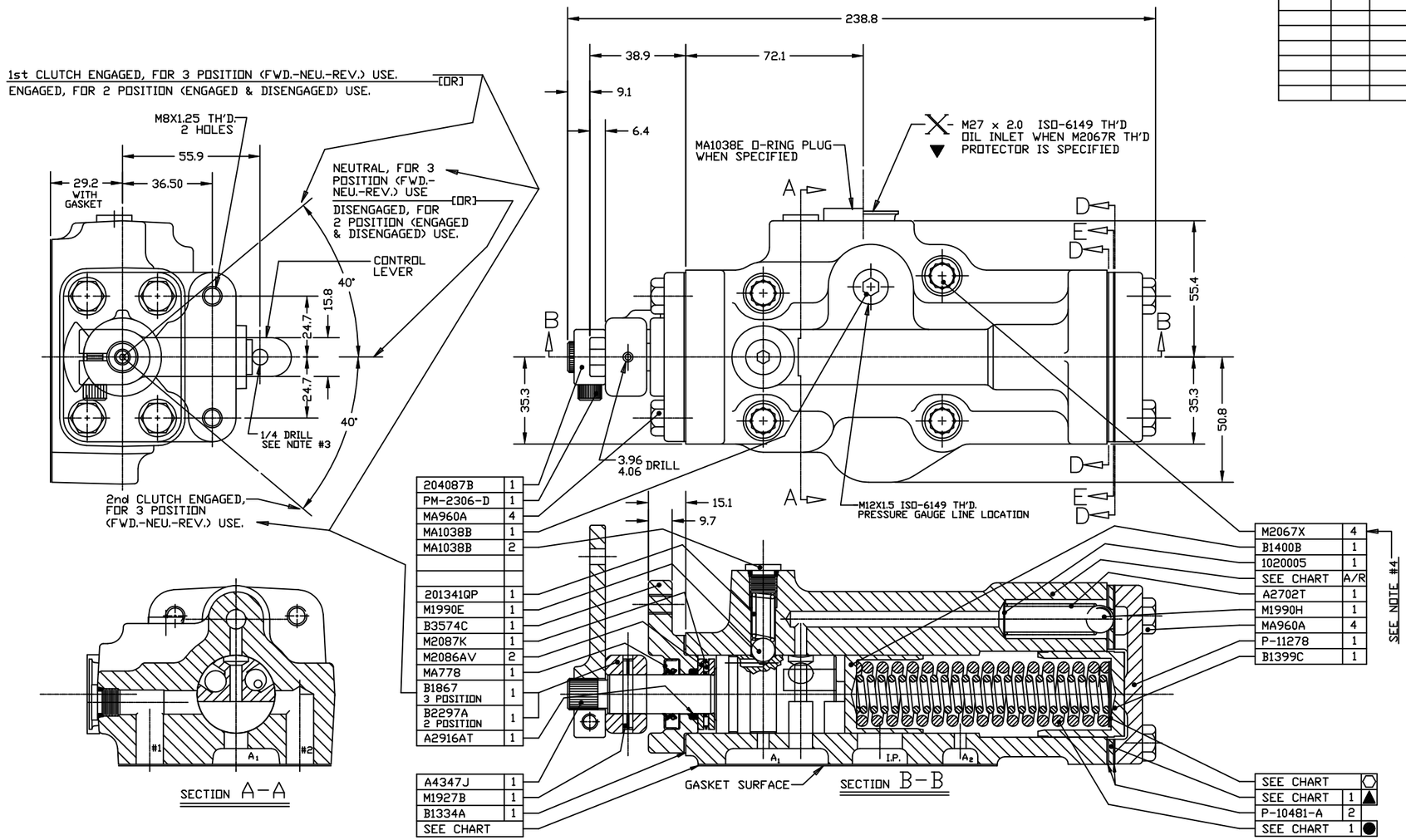
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
.XX ±0.25
.XXX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

THIRD ANGLE PROJECTION
SIMILAR TO
METRIC

DATE 12-7-93
SCALE NONE
DRN. KS
CHK. DAS
APPD. TBC

TWIN DISC INCORPORATED RACINE, WI 53403 - USA
A7119R
SHEET 1 OF 1 REV B

VALVE ASSEMBLY NUMBER	B.O.M.	VALVE BODY (SEE SECT. B-B)	VALVE BODY GASKET PART NO. QTY.	ORIFICE PLATE PART NO.	ORIFICE PLATE SIZE	COLLAR	X	VALVE SPRINGS ● SPRING ASS'Y.	VALVE SPRINGS ● CONSISTS OF: OUTER	CENTER	INNER	CLUTCH k.P.a. NOM.	SHIMS ○ PART NO.	SHIMS ○ QTY.	FIRST USE	DATE AND APPR.
Ⓑ Ⓐ 1020412	41806	1020411	B1337F 1	P-10479D	.95 L/S	B1867	M27 X 2 MA1038E▼	--------	A2707BD	A2704BU	A2702BC	1725	B2334	USE AS REQUIRED	MG-5222DC	



204087B	1
PM-2306-D	1
MA960A	4
MA1038B	1
MA1038B	2
201341QP	1
M1990E	1
B3574C	1
M2087K	1
M2086AV	2
MA778	1
B1867 3 POSITION	1
B2297A 2 POSITION	1
A2916AT	1
A4347J	1
M1927B	1
B1334A	1
SEE CHART	

M2067X	4
B1400B	1
1020005	1
SEE CHART	A/R
A2702T	1
M1990H	1
MA960A	4
P-11278	1
B1399C	1

SEE CHART		○
SEE CHART	1	▲
P-10481-A	2	
SEE CHART	1	●

TEST VALVES PER TEST SPEC. NO. CONTAINED IN VALVE SPECIFICATION

INSTALLATION DATA:

1.) VALVE SUITABLE FOR UP TO 95 L/min.

2.) CLUTCH PRESSURE IN NEUTRAL WILL BE BETWEEN 335 AND 296 k.P.a.

3.) 44-89 N AT THE 55.9 R LOCATION OF THE 6.4 ø HOLE IS REQUIRED TO OVERCOME DETENT EFFORT. REMOTE CONTROL VALVE ACTUATOR MUST PROVIDE ±35.8 LINEAR TRAVEL FROM NEUTRAL AT THE 6.4 ø HOLE LOCATION. (WHEN SUITABLE REMOTE CONTROLS ARE USED, THE DETENT SPRING AND PIN MAY BE OMITTED., THEN THE FORCE WILL BECOME 13-31 N) THE DETENT FEATURE IS PROVIDED IN THE FULL FORWARD, FULL REVERSE AND NEUTRAL LEVER POSITIONS.

4.) TORQUE MOUNTING BOLTS TO 57-68 N·m, 'AS RECIEVED' (PER S574) OR 47-56 N·m, 'LUBRICATED' (PER S574). AFTER TORQUING MOUNTING BOLTS, INSTALL M2067X PLUGS IN MOUNTING BOLT COUNTERBORES.

GENERAL NOTES:

▼ REMOVE BEFORE OPERATING UNIT, THREAD PROTECTOR.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO
PX9975
XA7540

REV	ZONE	CH. NO.	DATE
B	B6	ECN10472	11-15-01
A	B6	ECN10355	8-21-01

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MATERIAL: ----------
HEAT TREAT: ----------
SURFACE TREATMENT:
WEIGHT kg / wt N m
FIRST USE
ASSY. MODEL MG-5222DC
NAME VALVE ASSY, CONTROL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 8-2-01
SCALE 1" = 1"
DRN. W.Russell
CHK. ALC
APPD. ALC

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020412

SHEET 1 OF 1 REV B

VALVE ASSEMBLY NUMBER	B.O.M.	** VALVE BODY (SEE ALSO SECTION : "B-B").	VALVE BODY GASKET PART NO. QTY.	ORIFICE PLATE ▲ PART NO.	ORIFICE PLATE ▲ SIZE	X	VALVE SPRINGS ● SPRING ASS'Y.	VALVE SPRINGS ● CONSISTS OF: OUTER	CENTER	INNER	CLUTCH k.P.a. NOM.	SHIMS ◉ PART NO.	SHIMS ◉ QTY.	FIRST USE	DATE AND APPR.
1020413	41807	1020411	B-1337-F 1	P-10479-D	85 1.05	M27 X 2 MA1038E	-----	A-2707-BD	A-2704-BU	A-2702-BC	1725	B-2465-B	3	MG-5222DC	8-1-01 ALC

Ⓐ Ⓑ

TEST VALVES PER TEST SPEC.NO. B-2408-K
CONTAINED IN VALVE SPECIFICATION

INSTALLATION DATA:

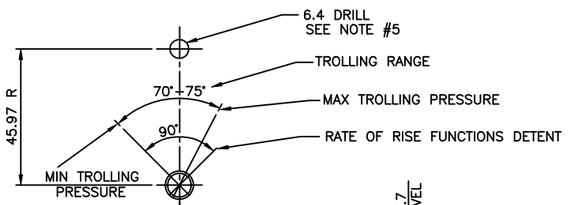
1.) VALVE SUITABLE FOR UP TO 95 L/min.

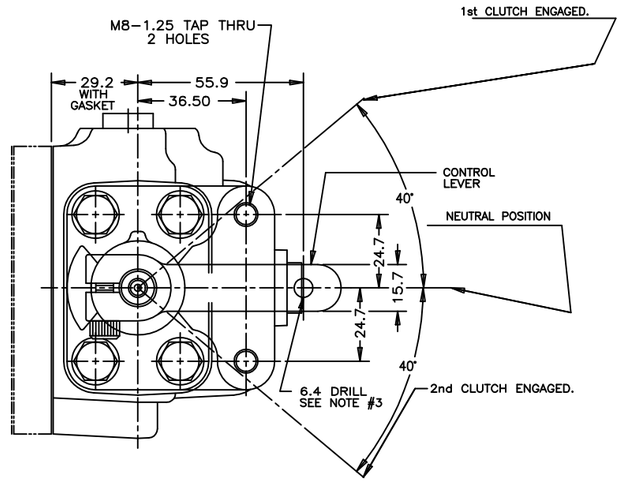
2.) CLUTCH PRESSURE IN NEUTRAL WILL BE BETWEEN 255 AND 296 kPa

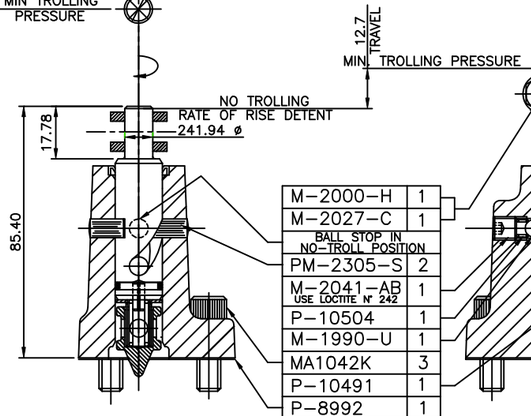
3.) 44-89 N AT THE 55.9 R LOCATION OF THE 6.4 ø HOLE IS REQUIRED TO OVERCOME DETENT EFFORT. REMOTE CONTROL VALVE ACTUATOR MUST PROVIDE ±35.8 LINEAR TRAVEL FROM NEUTRAL AT THE 6.4 ø HOLE LOCATION. (WHEN SUITABLE REMOTE CONTROLS ARE USED, THE DETENT SPRING AND PIN MAY BE OMITTED, THEN THE FORCE WILL BECOME 13-31 N) THE DETENT FEATURE IS PROVIDED IN THE FULL FORWARD, FULL REVERSE AND NEUTRAL LEVER POSITIONS.

4.) TORQUE MOUNTING BOLTS TO 57-68 N m , "AS RECEIVED" (PER S574) OR 47-56 N·m , "LUBRICATED" (PER S574). AFTER TORQUING MOUNTING BOLTS, INSTALL M2067X PLUGS IN MOUNTING BOLT COUNTERBORES.

5.) CONTROL HEAD FOR TROLLING VALVE MUST INCLUDE A DEVICE TO LOCK TROLLING VALVE CONTROL LEVER IN THE DETENTED NO-TROLL POSITION DURING MANEUVERING, DOCKING AND OTHER OPERATING CONDITIONS THAT REQUIRE FULL POWER TO THE PROPELLER.







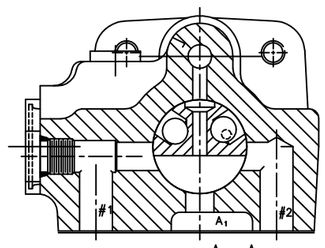
M-2000-H	1
M-2027-C	1
BALL STOP IN NO-TROLL POSITION	
PM-2305-S	2
M-2041-AB USE LOCTITE N° 242	1
P-10504	1
M-1990-U	1
MA1042K	3
P-10491	1
P-8992	1

B-2103	1
P-8449	1
PM-5591	1
P-8445	1
PM-3036-M	1
A2916DD	1
PM-2057-AC AS REQUIREMENT	1
A-2701-BM	1 Ⓐ
A-2701-BN	1 Ⓑ

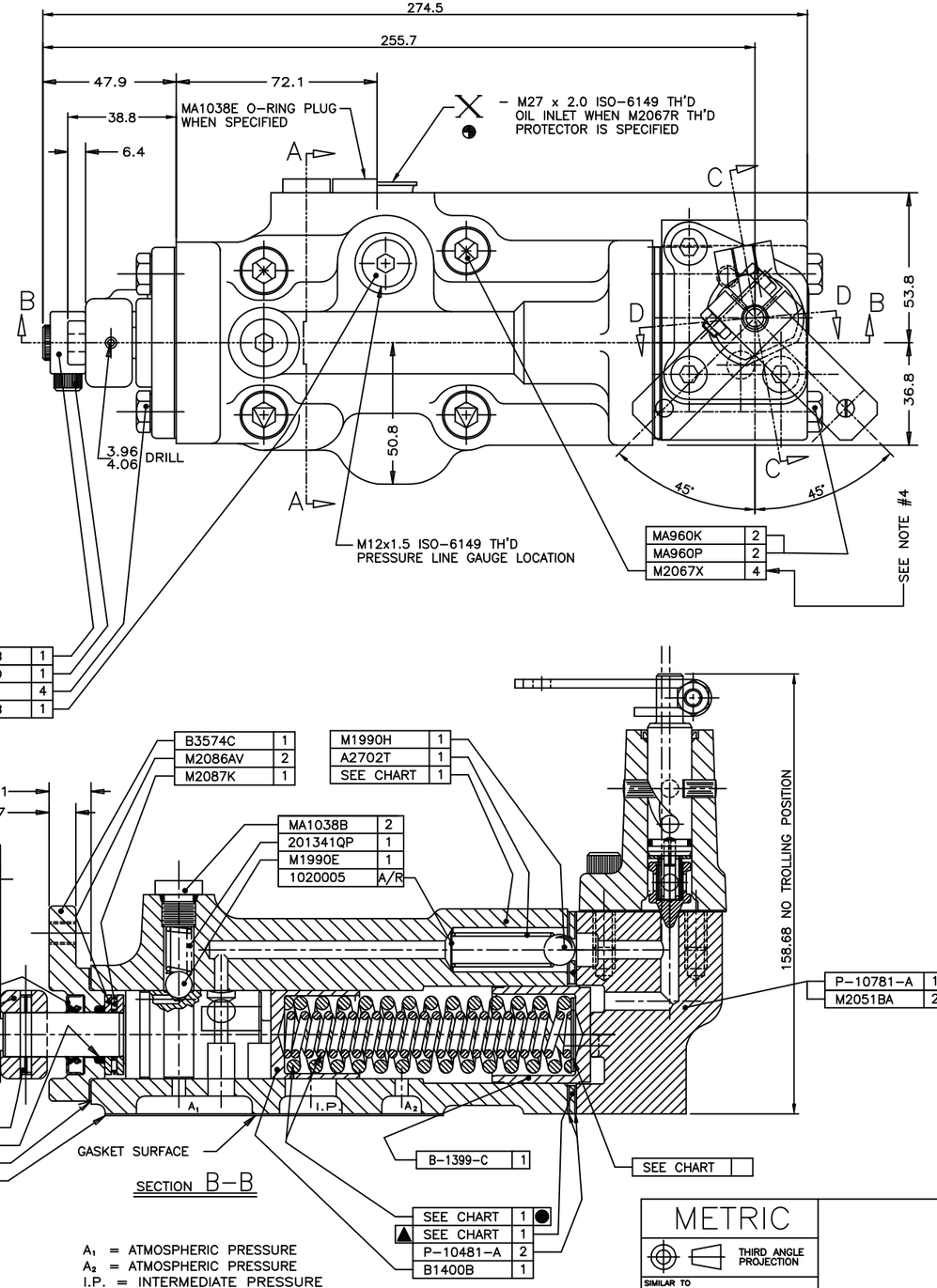
SECTION : " D-D"

SECTION : " C-C"

MANUAL TROLLING VALVE



SECTION A-A

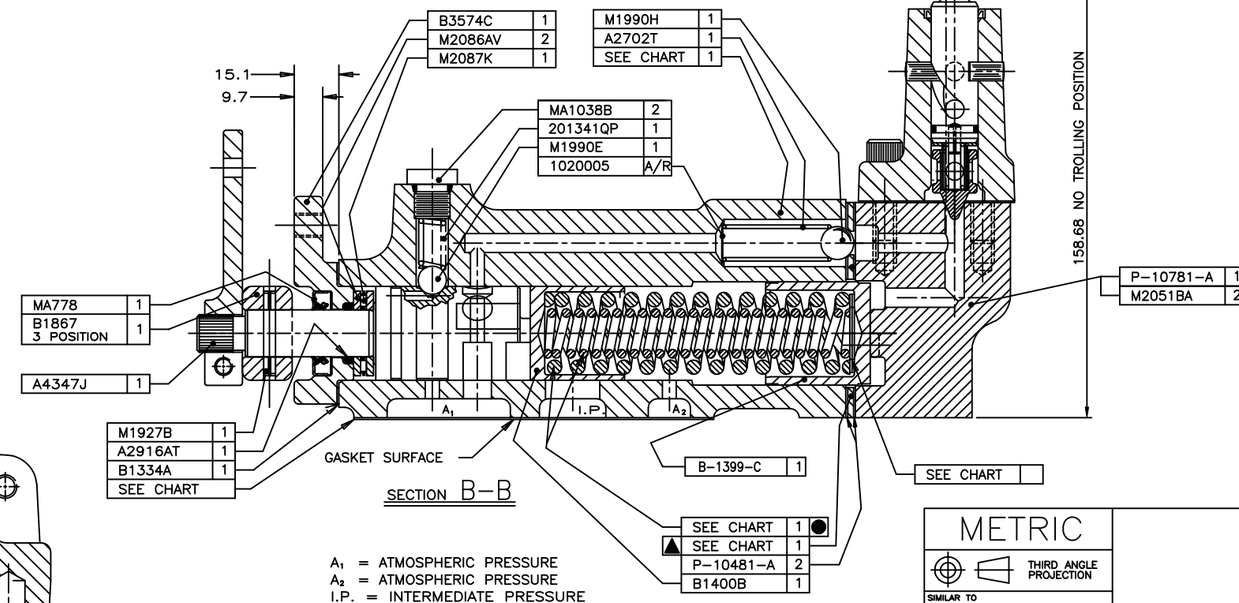


MA960K	2
MA960P	2
M2067X	4

204087B	1
PM2306D	1
MA960A	4
MA1038B	1

B3574C	1
M2086AV	2
M2087K	1

M1990H	1
A2702T	1
SEE CHART	1



MA1038B	2
201341QP	1
M1990E	1
1020005	A/R

P-10781-A	1 Ⓑ
M2051BA	2

MA778	1
B1867 3 POSITION	1
A4347J	1

M1927B	1
A2916AT	1
B1334A	1
SEE CHART	

B-1399-C	1

SEE CHART	

SEE CHART	1 ●
SEE CHART	1 ▲
P-10481-A	2
B1400B	1

SECTION B-B

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

GENERAL NOTES:

● REMOVE BEFORE OPERATING UNIT, THREAD PROTECTOR

* NOT SERVICEABLE SEPARATELY.

◉ THESES PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

REV	ZONE	CH. NO.	DATE
B	D2 F6	ECN10472	11-15-01
A	D2 F6	ECN10355	8-21-01

NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 - USA
THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERNMENT OR OTHERS BY CONTRACT.

MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg | wt² N-m²
FIRST USE ASSY. 1020413 MODEL MG-5222DC
NAME

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS X ±0.75 X.X ±0.25 X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 8-3-01
SCALE 1 = 1
DRN. W.Russell
CHK. ALC
APPD. GAM

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO PX10790

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020413

SHEET 1 OF 1 REV B

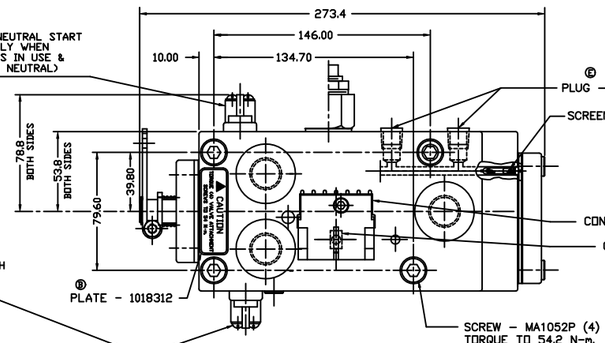
WIRING DIAGRAM:

CONNECTOR

PORT 'A' SOLENOID — A
PORT 'B' SOLENOID — B
NEUTRAL SOLENOID — C
D
E
F

MANUAL OVERRIDE NEUTRAL START SWITCH (CLOSED ONLY WHEN MANUAL OVERRIDE IS IN USE & TRANSMISSION IS IN NEUTRAL) MAX. I = 20 A.

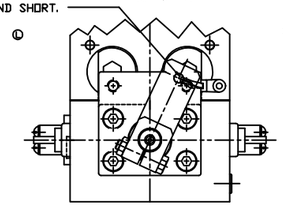
OPTIONAL:
MATING WIRING HARNESS 1017403 SERIES (SPECIFY LENGTH).



ELECTRIC CONTROL MODE SWITCH (CLOSED WHEN MANUAL VALVE STEM IS LOCKED IN ELECTRIC MODE.) MAX. I = 20 A.

TOP VIEW

NOTE:
SECURE LEVER IN THE DEPRESSED 'ELECTRIC CONTROL MODE' POSITION BY LOOPING PLASTIC STRAP THRU 1/4" HOLE IN LEVER & M8 THREADED HOLE BEHIND – PULL TIGHT, TRIM END SHORT.



STRAP – M2942B

NOTE:
INSTALL USING MA908 (LOCTITE #242). THREAD DOG POINT INTO DETENT GROOVE UNTIL SNUG. BACK-OFF 1/2 TURN.

THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.

SETSCREW – M2038W

SPRING – A2702BQ (2) (HYDRAULIC LOCK ONLY)

PIN – A2711AC (2) (HYDRAULIC LOCK ONLY)

SPOOL – 1017432 (2) (HYDRAULIC LOCK ONLY)

PLUG – MA1038E (2)

PISTON – SEE CHART (N)

RACE – M2086DF

(AG) BEARING – M2087AD

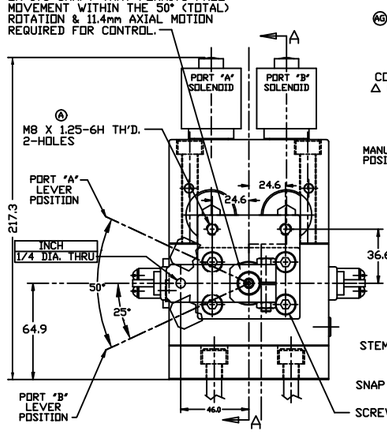
RACE – M2086R

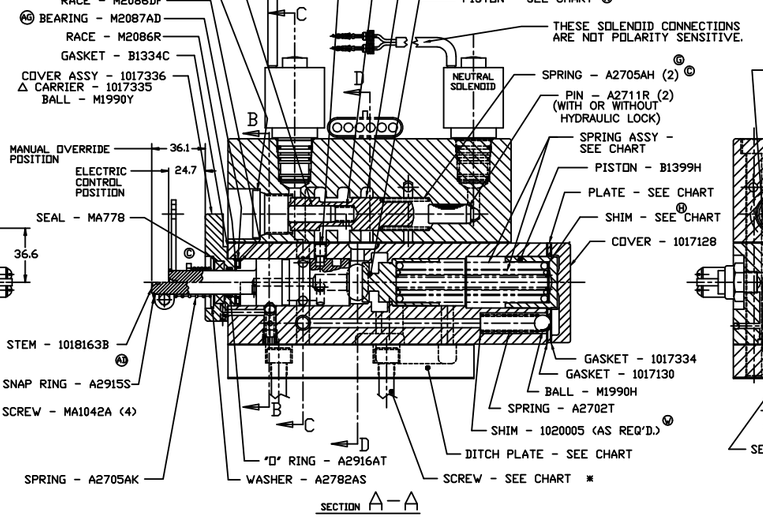
GASKET – B1334C

COVER ASSY – 1017336
△ CARRIER – 1017335
BALL – M1990Y

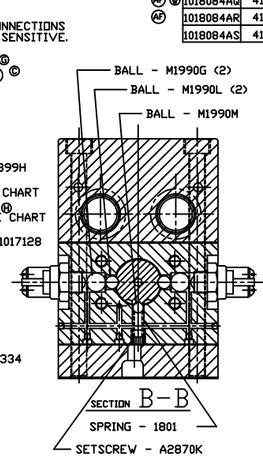
THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.

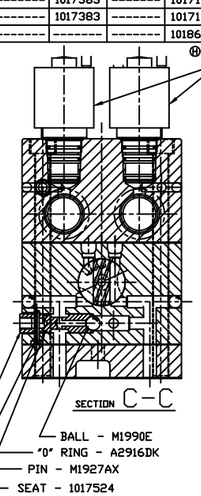
NOTE:
LEVER MAY BE LOCATED ANYWHERE ON ITS SHAFT THAT PERMITS FREE MOVEMENT WITHIN THE 50° (TOTAL) ROTATION & 11.4mm AXIAL MOTION REQUIRED FOR CONTROL.

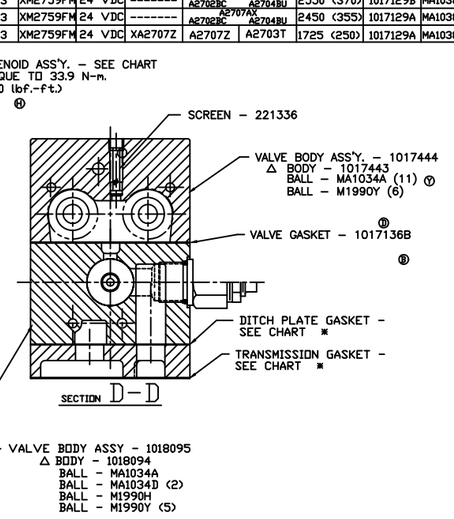




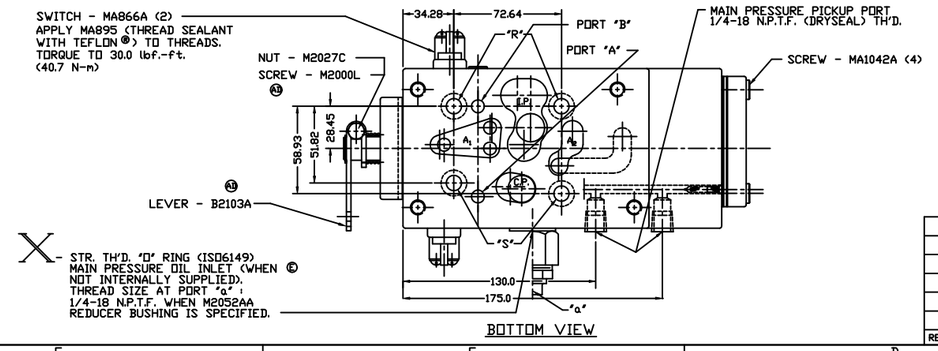
SECTION A–A






SCREEN – 221336
VALVE BODY ASS'Y. – 1017444
△ BODY – 1017443
BALL – MA1034A (11) (Y)
BALL – M1990Y (6)
VALVE GASKET – 1017136B (D)
DITCH PLATE GASKET – SEE CHART *
TRANSMISSION GASKET – SEE CHART *
SECTION D–D
VALVE BODY ASSY – 1018095
△ BODY – 1018094
BALL – MA1034A
BALL – MA1034D (2)
BALL – M1990H
BALL – M1990Y (5)

NOTE:
INSTALL USING MA908 (LOCTITE #242) TOP OF SCREW MUST BE FLUSH WITH SURFACE.



BOTTOM VIEW

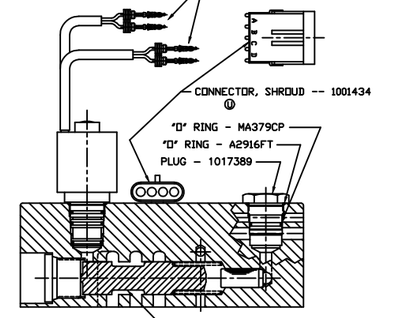
VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	PISTON	HYDRAULIC LOCK?	SOLENOID QTY.	SOLENOID No.	VOLTAGE	VALVE SPRINGS ASS'Y	VALVE SPRINGS CONSISTS OF: OUTER	VALVE SPRINGS CONSISTS OF: INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	X	SHIMS PART NO.	SHIMS APPX. QTY.	MOUNTING SCREWS "R"	MOUNTING SCREWS QTY.	MOUNTING SCREWS "S"	MOUNTING SCREWS QTY.	FIRST USE	DATE AND APPR.
(AE) (AA) 1018084	40750	1017133	1017134	B1337F	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		MA1052A	2	MA1052A	2	MG-5202DC	3-17-98 DAS/BJE
1018084A	40751	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BD	A2704BU	2415 (350)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		-------		-------		MG-6619RV	3-17-98 DAS/BJE
(AA) 1018084B	40752	1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L MA1053G M2052AA MA1053G M2052AA	B2451B		M2089F	2	M2089AG	2	DD-514V	3-17-98 DAS/BJE
□ 1018084C	40753	1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L MA1053G M2052AA MA1053G M2052AA	B2451B		M2089Y	1	M2089F	3	DD-516V	3-17-98 DAS/BJE
(AA) 1018084D	40754	1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L MA1053G M2052AA MA1053G M2052AA	B2451B		M2089F	2	M2089AG	2	DD-514V	3-17-98 DAS/BJE
□ 1018084E	40755	1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L MA1053G M2052AA MA1053G M2052AA	B2451B		M2089Y	1	M2089F	3	DD-516V	3-17-98 DAS/BJE
(AA) 1018084F	40756	1017133A	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	3-17-98 DAS/BJE
(AA) 1018084G	40757	1017133A	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	3-17-98 DAS/BJE
(Z)(P)(F) 1018084H	40758	1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	3-17-98 DAS/BJE
(Z)(P)(F) 1018084J	40761	1017583	1017569	1017613	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	3-17-98 DAS/BJE
(AA) 1018084K	40762	1017133A	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD		1585 (230)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		MA1052B	2	MA1052B	2	MG-5114	3-17-98 DAS/BJE
(AA) 1018084L	40763	1017133A	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD		1585 (230)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		MA1052B	2	MA1052B	2	MG-5114	3-17-98 DAS/BJE
(F) 1018084M	40764	-------	1017383	-------	1018688	NO	2	XM2759FM	24 VDC	A2702BC	A2707AX A2704BU		2415 (350)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		-------		-------		MG-5984 61242	3-17-98 DAS/BJE
(Z)(P)(F) 1018084N	40775	1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062J	2	MG-5600DR	4-8-98 DAS
(AA)(T)(R)(N)(F) 1018084P	40817	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		-------		-------		MG-6550SC	7-23-98 DAS/AZ
(AE) (AA) (K) (V) 1018084Q	40842	1017133	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		MA1052K	2	MA1052K	2	MG-5202SC	8-5-98 DAS/DM
(V) 1018084R	40935	-------	1017383	-------	1017179	YES	3	XM2759FM	24 VDC	-------	A2707BD	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		-------		-------		MG-6557	10-9-98 JHB/DAS
(AC) (AA) □ 1018084S	40954	1018584	1018594	B3117A	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M1732AH	2	M1732AH	2	MG-540	11-6-98 DAS/BJE
1018084T	40955	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BD A2702BC	A2704BU	2655 (385)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		-------		-------		MG-6449	11-6-98 DAS/BJE
(AF) (V) 1018084U	40956	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	7	-------		-------		MG-6557	11-6-98 DAS/BJE
(AF) 1018084V	40957	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2450 (355)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	5	-------		-------		MG-6600 MG-6619	11-6-98 DAS/BJE
(AE) (AA) (J) 1018084W	40958	1017133	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052A	2	MA1052A	2	MG-5202DC	11-18-98 VR/VTV
(AA) 1018084X	40964	1017133A	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	M2089AR	2	M2089AR	2	MG-5141	11-24-98 RW/VTV
(T)(R)(G) 1018084Y	41028	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-6550SC	12-2-98 JLM/DAS
(AA) (R) 1018084Z	41045	-------	1017134	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5205DC	2-18-99 JS/BJE
(Z) 1018084AA		1017583	1017569	1017613	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062J	2	MG-5600DR	
(AE) (AA) 1018084AB	41093	1017133	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052A	2	MA1052A	2	MG-5202DC	5-26-99 JS/VTV
1018084AC	40967	-------	1017383	-------	1017179	YES	3	XM2759FM	24 VDC	-------	A2707BD A2702BC	A2704BU	2655 (385)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-6449-RV	7-9-99 JS/DAS
(S)(B) 1018084AD	41114	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	-------	A2707BD A2702BC	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-6848SC	8-2-99 ALC/DAS
(S)(B) 1018084AE	41115	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	-------	A2707BD A2702BC	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-6848SC	8-2-99 ALC/DAS
(AE) (AA) 1018084AF	41118	1017133	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052K	2	MA1052K	2	MG-5202SC	8-11-99 JS/DAS
(AE) (AA) 1018084AG	41163	-------	1017134	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5205DC	11/19/99 ALC/DAS
(AG) (V) 1018084AH	41171	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5170DC	11/19/99 ALC/DAS
(AA) (V) 1018084AJ	41172	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5170DC	11/19/99 ALC/DAS
(AG) (AA) (V) □ 1018084AK	41244	1018584	1018594	B3117A	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	M1732AH	2	M1732AH	2	MG-540	2/11/00 ALC/DAS
(AA) 1018084AL	41250	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-520-1HP	2/11/00 ALC/DAS
(AA) 1018084AM	41251	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-520-1HP	2/11/00 ALC/DAS
(AA) 1018084AN	41196	-------	-------	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5141SC	3/21/00 ALC/DAS
(AA) 1018084AP	41195	-------	-------	-------	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5141SC	3/21/00 ALC/DAS
(AF) (V) 1018084AQ	41337	-------	1017383	-------	1017179	YES	3	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	7	-------		-------		MG-6557	4/24/00 ALC/BJE
(AF) 1018084AR	41446	-------	1017383	-------	1017179	YES	3	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2450 (355)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	5	-------		-------		MG-6600 MG-6619	6/21/00 JLM/ALC
1018084AS	41718	-------	-------	-------	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-------		-------		MG-5170DC	4/16/01 JR/ALC

(H)

PARTS FOR UNITS WITHOUT NEUTRAL SOLENOID AND HYDRAULIC LOCK (OPTIONAL CONDITION)

WIRING DIAGRAM: OPTIONAL:
MATING WIRING HARNESS 1017404 SERIES (SPECIFY LENGTH).

CONNECTOR
PORT 'A' SOLENOID — A
PORT 'B' SOLENOID — B
C
D


THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.
CONNECTOR, SHROUD -- 1001434 (J)
"O" RING – MA379CP
"O" RING – A2916FT
PLUG – 1017389
SPOOL – 1017433 (2)

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

(AJ) □ OBSOLETE FOR PRODUCTION AND SERVICE

△ NOT SERVICEABLE SEPARATELY

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

REV	ZONE	CH. NO.	DATE
AG		ECN10415	1-11-02
AF	A-4,-5	ECN10553	12-3-01

NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 – USA
THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERNMENT OR OTHERS BY CONTRACT.

MATERIAL: ----------
HEAT TREAT: ----------
SURFACE TREATMENT:
WEIGHT kg / WR² N·m²
FIRST USE: ASSY. 1015207 MODEL MG-5202DC
NAME: VALVE ASS'Y. – CONTROL (WITHOUT TROLLING VALVE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
.XX ±0.25
.XXX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 3-23-98
SCALE .50 = 1.00
DRN. RM
CHK. RM/BJE
APPD. DAS

HYDRAULIC DIAGRAM A7119W, SHEET 1 OF 2

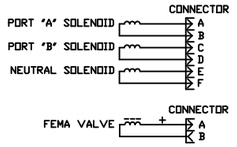
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

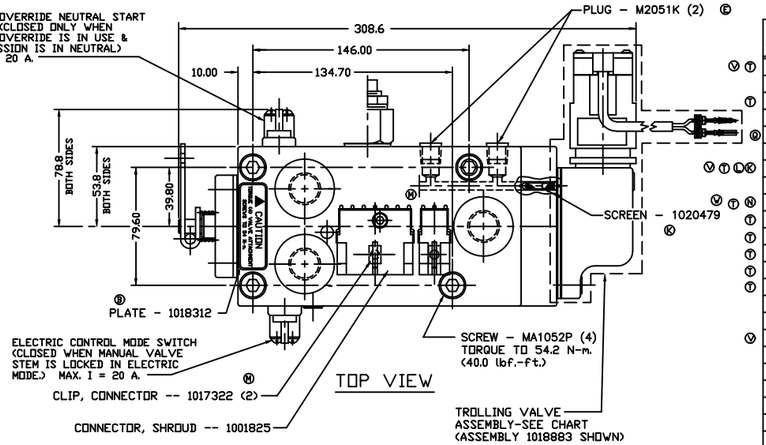
1018084 SERIES

SHEET 1 OF 1 REV AG

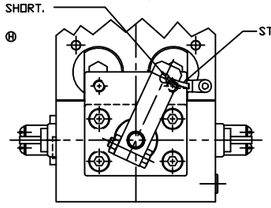
WIRING DIAGRAM:



OPTIONAL:
MATING WIRING HARNESS 1017502 SERIES (SPECIFY LENGTH).

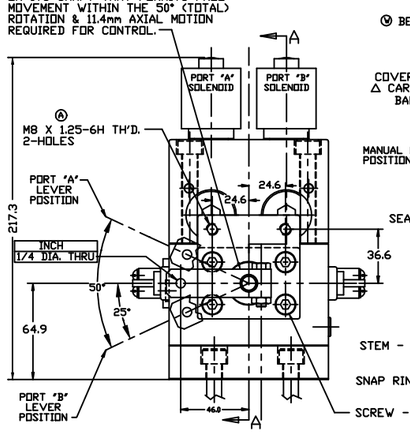

MANUAL OVERRIDE NEUTRAL START SWITCH (CLOSED ONLY WHEN MANUAL OVERRIDE IS IN USE & TRANSMISSION IS IN NEUTRAL) MAX. I = 20 A.
PLUG - M2051K (2) E
308.6
146.00
134.70
10.00
78.8 BOTH SIDES
53.8 BOTH SIDES
39.80
79.60
SCREEN - 1020479 K
B PLATE - 1018312
ELECTRIC CONTROL MODE SWITCH (CLOSED WHEN MANUAL VALVE STEM IS LOCKED IN ELECTRIC MODE.) MAX. I = 20 A. N
CLIP, CONNECTOR -- 1017322 (2)
CONNECTOR, SHROUD -- 1001825
SCREW - MA1052P (4) TORQUE TO 54.2 N-m. (40.0 lbf.-ft.)
TROLLING VALVE ASSEMBLY-SEE CHART (ASSEMBLY 1018883 SHOWN)
TOP VIEW

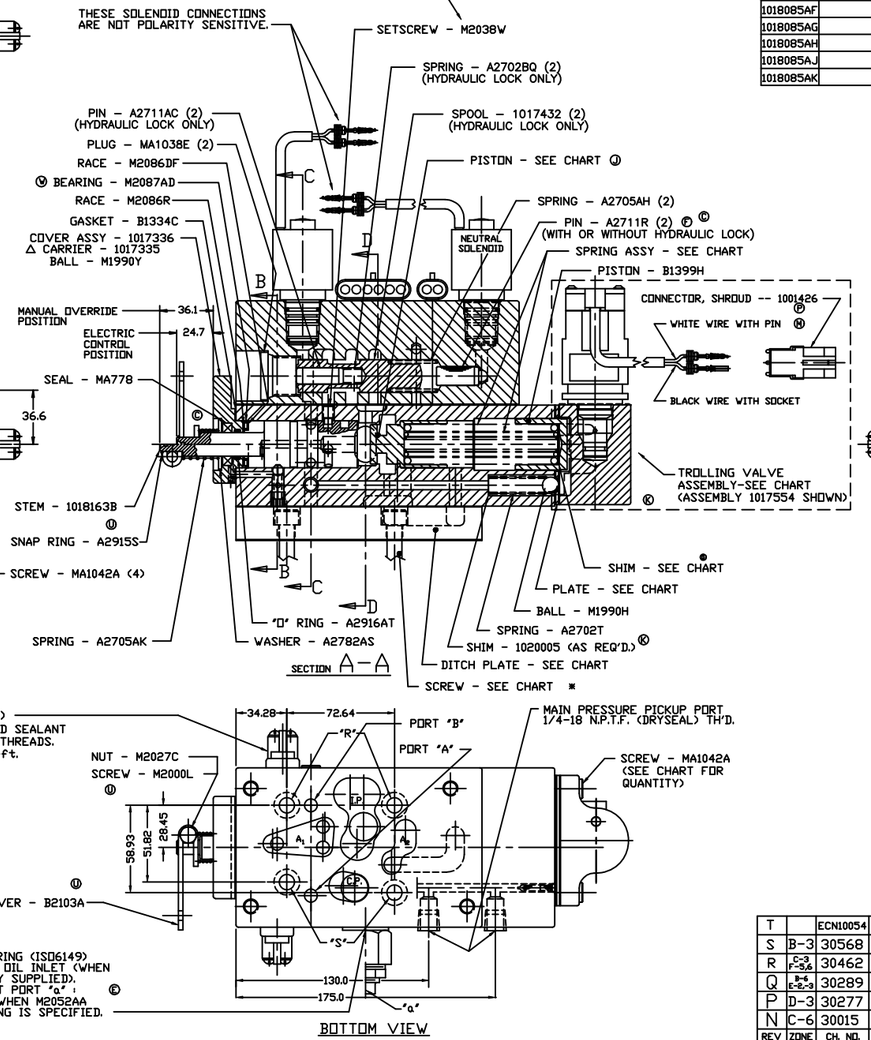
NOTE:
SECURE LEVER IN THE DEPRESSED 'ELECTRIC CONTROL MODE' POSITION BY LOOPING PLASTIC STRAP THRU 1/4" HOLE IN LEVER & M8 THREADED HOLE BEHIND - PULL TIGHT, TRIM END SHORT.

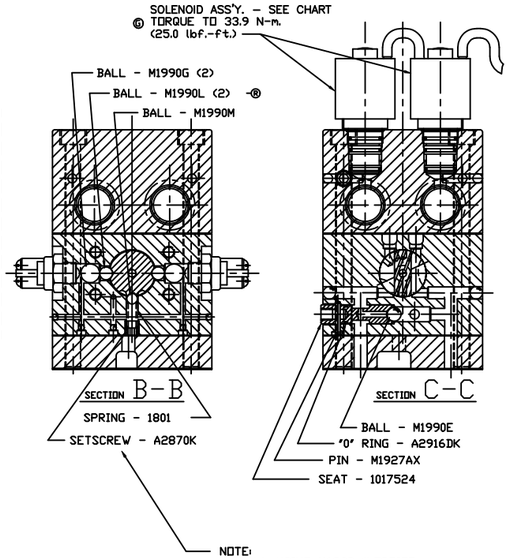


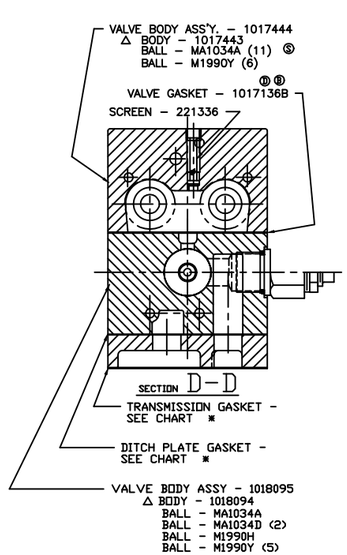
NOTE:
INSTALL USING MA908 (LOCTITE #242). THREAD DOG POINT INTO DETENT GROOVE UNTIL SNUG. BACK-OFF 1/2 TURN.

NOTE:
LEVER MAY BE LOCATED ANYWHERE ON ITS SHAFT THAT PERMITS FREE MOVEMENT WITHIN THE 50° (TOTAL) ROTATION & 11.4mm AXIAL MOTION REQUIRED FOR CONTROL.



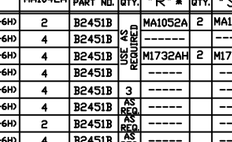

THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.
SETSCREW - M2038W
SPRING - A2702BQ (2) (HYDRAULIC LOCK ONLY)
PIN - A2711AC (2) (HYDRAULIC LOCK ONLY)
SPOOL - 1017432 (2) (HYDRAULIC LOCK ONLY)
PLUG - MA1038E
PISTON - SEE CHART J
RACE - M2086DF
V BEARING - M2087AD
RACE - M2086R
SPRING - A2705AH (2)
GASKET - B1334C
PIN - A2711R (2) F C (WITH OR WITHOUT HYDRAULIC LOCK)
COVER ASSY - 1017336
△ CARRIER - 1017335
BALL - M1990Y
SPRING ASSY - SEE CHART
PISTON - B1399H
NEUTRAL SOLENOID
CONNECTOR, SHROUD -- 1001426 P
WHITE WIRE WITH PIN H
BLACK WIRE WITH SOCKET
MANUAL OVERRIDE POSITION
ELECTRIC CONTROL POSITION
36.1
24.7
SEAL - MA778
STEM - 1018163B U
SNAP RING - A2915S
SCREW - MA1042A (4)
TROLLING VALVE ASSEMBLY-SEE CHART (ASSEMBLY 1017554 SHOWN) K
SHIM - SEE CHART •
PLATE - SEE CHART
BALL - M1990H
SPRING - A2702T
SHIM - 1020005 (AS REQ'D.) K
DITCH PLATE - SEE CHART
SCREW - SEE CHART *
"O" RING - A2916AT
WASHER - A2782AS
SPRING - A2705AK
SECTION A-A


SOLENOID ASS'Y. - SEE CHART
G TORQUE TO 33.9 N-m. (25.0 lbf.-ft.)
BALL - M1990G (2)
BALL - M1990L (2) R
BALL - M1990M
SECTION B-B
SPRING - 1801
SETSCREW - A2870K
SECTION C-C
BALL - M1990E
"O" RING - A2916DK
PIN - M1927AX
SEAT - 1017524
NOTE:
INSTALL USING MA908 (LOCTITE #242) TOP OF SCREW MUST BE FLUSH WITH SURFACE.


VALVE BODY ASS'Y. - 1017444
△ BODY - 1017443
BALL - MA1034A (11) S
BALL - M1990Y (6)
VALVE GASKET - 1017136B D R
SCREEN - 221336
SECTION D-D
TRANSMISSION GASKET - SEE CHART *
DITCH PLATE GASKET - SEE CHART *
VALVE BODY ASSY - 1018095
△ BODY - 1018094
BALL - MA1034A
BALL - MA1034D (2)
BALL - M1990H
BALL - M1990Y (5)

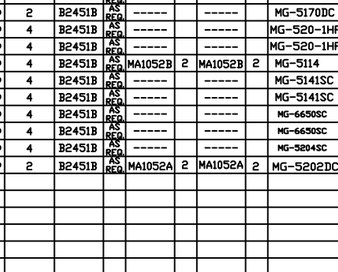
PARTS FOR UNITS WITHOUT NEUTRAL SOLENOID AND HYDRAULIC LOCK (OPTIONAL CONDITION)

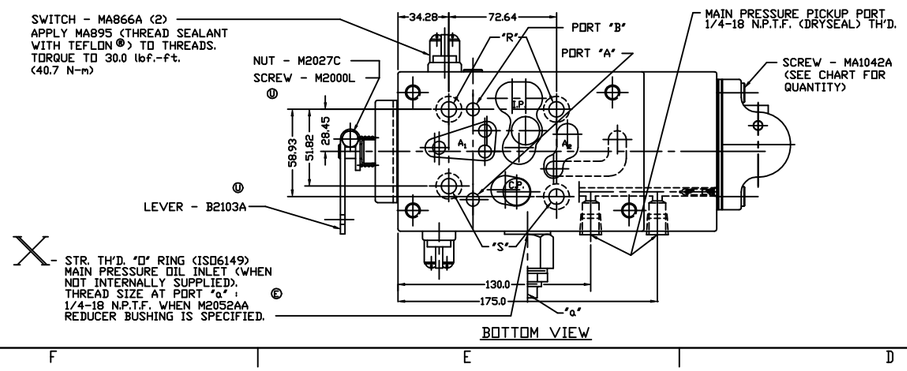
WIRING DIAGRAM:



OPTIONAL:
MATING WIRING HARNESS 1017501 SERIES (SPECIFY LENGTH).

THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.





X - STR. TH'D. "O" RING (ISO6149) MAIN PRESSURE OIL INLET (WHEN NOT INTERNALLY SUPPLIED). THREAD SIZE AT PORT "a": 1/4-18 N.P.T.F. WHEN M2052AA REDUCER BUSHING IS SPECIFIED. E

K □ THE 1018883 TROLLING VALVE IS REQUIRED TO PROVIDE CLEARANCE FROM THE HYDRAULIC PTO.

△ NOT SERVICEABLE SEPARATELY

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	PISTON	HYD-RAULIC LOCK?	SOLENOID QTY.	SOLENOID No.	VOLTAGE	VALVE SPRINGS SPRING ASS'Y	VALVE SPRINGS CONSISTS OF : OUTER	VALVE SPRINGS CONSISTS OF : INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	TROLLING VALVE ASS'Y □	X	QTY OF MA1042A	SHIMS PART NO.	SHIMS QTY.	MOUNTING SCREWS "R" #	MOUNTING SCREWS QTY.	MOUNTING SCREWS "S" #	MOUNTING SCREWS QTY.	FIRST USE	DATE AND APPR.
V T 1018085	40759	1017133	1017134	B1337F	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	1018883	MA1038E(M27 X 2.0-6H)	2	B2451B		MA1052A	2	MA1052A	2	MG-5202DC	3-17-98 DAS/BJE
T 1018085A	40760	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BD	A2704BU	2415 (350)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B		-------		-------		MG-6619RV	3-17-98 DAS/BJE
T 1018085B		1018584	1018594	B3117A	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B		M1732AH	2	M1732AH	2	MG-540	11-6-98 DAS/BJE
1018085C	41079	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BU A2702BC	A2704BU	2655 (385)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B		------		------		MG-6449	11-6-98 DAS/BJE
1018085D	41113	-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2550 (370)	1017129B	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	3	------		------		MG-6557	11-6-98 DAS/BJE
1018085E		-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AX A2702BC	A2704BU	2450 (355)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-6600 MG-6619	11-6-98 DAS/BJE
V T 1018085F		-------	1017134	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	1018883	MA1038E(M27 X 2.0-6H)	2	B2451B	AS REQ'D.	------		------		MG-5205DC	6-24-99 ALC/DAS
V T 1018085G	41152	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	-------	A2707BD A2702BC	A2704BU	2415 (350)	1017129B	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-6848SC	11/19/99 ALC/DAS
V T 1018085H	41173	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	1018883	MA1038E(M27 X 2.0-6H)	2	B2451B	AS REQ'D.	------		------		MG-5170DC	11/19/99 ALC/DAS
T 1018085J	41256	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-520-1HP	12/16/00 ALC/DAS
T 1018085K	41255	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-520-1HP	12/16/00 ALC/DAS
T 1018085L	41266	1017133A	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD	-------	1585 (230)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	MA1052B	2	MA1052B	2	MG-5114	2/29/00 ALC/DAS
T 1018085M	41304	-------	-------	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD	A2703BA	1860 (270)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-5141SC	3/21/00 ALC/DAS
T 1018085N	41305	-------	-------	-------	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD	A2703BA	1860 (270)	1017129A	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-5141SC	3/21/00 ALC/DAS
1018085P	41308	-------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-6650SC	3/21/00 ALC/DAS
1018085R	41310	-------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-6650SC	3/21/00 ALC/DAS
V 1018085S	41709	-------	1017134	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	1017554	MA1038E(M27 X 2.0-6H)	4	B2451B	AS REQ'D.	------		------		MG-5204SC	4/6/01 KS/ALC
1018085T	41915	1017133	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	1018883	MA1038E(M27 X 2.0-6H)	2	B2451B	AS REQ'D.	MA1052A	2	MA1052A	2	MG-5202DC	1-11-00 ALC/GAH
1018085U																									
1018085V																									
1018085W																									
1018085X																									
1018085Y																									
1018085Z																									
1018085AA																									
1018085AB																									
1018085AC																									
1018085AD																									
1018085AE																									
1018085AF																									
1018085AG																									
1018085AH																									
1018085AJ																									
1018085AK																									

REV	ZONE	CH. NO.	DATE
T		ECN10054	4-18-01
S	B-3	30568	2-06-01
R	C-3 F-5,6	30462	11-16-00
Q	B-4 E-2,3	30289	8-30-00
P	D-3	30277	8-30-00
N	C-6	30015	4-12-00

REV	ZONE	CH. NO.	DATE
W		ECN10415	1-11-02
V		ECN10465	10-26-01
U	E-2 F-1	ECN10249	6-20-01

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MATERIAL: ---------
HEAT TREAT: ----------
SURFACE TREATMENT:
WEIGHT kg / WT lb
FIRST USE ASSY. 1015207 MODEL MG-5202DC
NAME: VALVE ASS'Y. - CONTROL (WITH TROLLING VALVE)
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 3-23-98
SCALE .50 = 1.00
DRN. RM
CHK. RM/BJE
APPD. DAS

HYDRAULIC DIAGRAM A7119W, SHEET 1 OF 2

METRIC

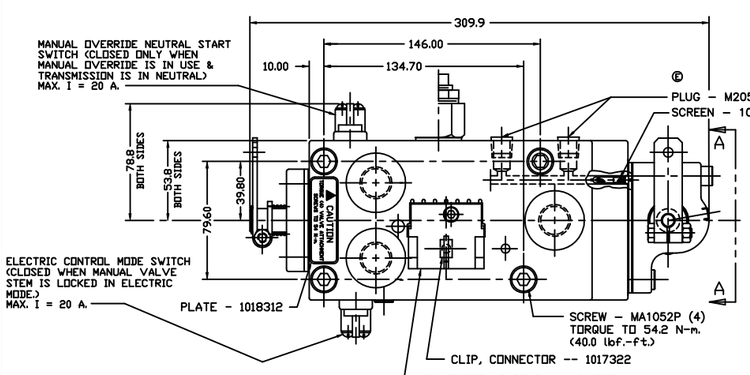
THIRD ANGLE PROJECTION

SIMILAR TO

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

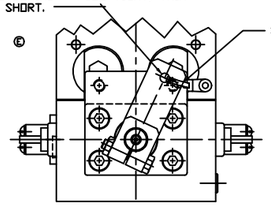
1018085 SERIES

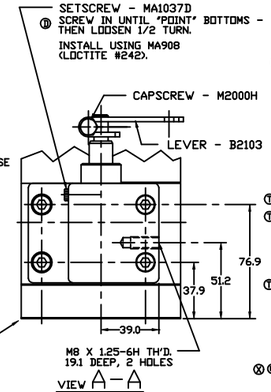
SHEET 1 OF 1 REV W


309.9
146.00
134.70
10.00
MANUAL OVERRIDE NEUTRAL START SWITCH (CLOSED ONLY WHEN MANUAL OVERRIDE IS IN USE & TRANSMISSION IS IN NEUTRAL) MAX. I = 20 A.
PLUG - M2051K (2)
SCREEN - 1020479 Ⓨ
78.8 BOTH SIDES
53.8 BOTH SIDES
39.80
79.60
ELECTRIC CONTROL MODE SWITCH (CLOSED WHEN MANUAL VALVE STEM IS LOCKED IN ELECTRIC MODE.) MAX. I = 20 A.
PLATE - 1018312
SCREW - MA1052P (4) TORQUE TO 54.2 N-m. (40.0 lbf.-ft.)
CLIP, CONNECTOR -- 1017322
CONNECTOR, SHROUD -- 1001825
A
A

TOP VIEW

NOTE:
SECURE LEVER IN THE DEPRESSED 'ELECTRIC CONTROL MODE' POSITION BY LOOPING PLASTIC STRAP THRU 1/4" HOLE IN LEVER & M8 THREADED HOLE BEHIND - PULL TIGHT, TRIM END SHORT.

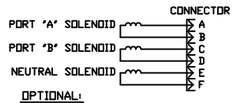




VIEW A-A

Ⓓ INSTALLATION NOTE:
0.6-0.9 N (5.5-8.3 lb.) AT THE 46.0 (1.81") R LOCATION OF THE 6.4mm (1/4") DIA. HOLE IS REQUIRED TO OVERCOME DETENT. REMOTE CONTROL ACTUATOR MUST PROVIDE 65.0mm (2.56") TOTAL LINEAR TRAVEL AT THE 6.4mm (1/4") DIA. HOLE.

WIRING DIAGRAM:



OPTIONAL:
MATING WIRING HARNESS 1017403 SERIES (SPECIFY LENGTH).

VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	PISTON	HYD-RAULIC LOCK?	SOLENOID QTY.	SOLENOID No.	VOLTAGE	VALVE SPRINGS SPRING ASS'Y	VALVE SPRINGS CONSISTS OF: OUTER	VALVE SPRINGS CONSISTS OF: INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	X	SHIMS PART NO.	SHIMS APPX. QTY.	MOUNTING SCREWS "R" ⋇	MOUNTING SCREWS QTY.	MOUNTING SCREWS "S" ⋇	MOUNTING SCREWS QTY.	FIRST USE	DATE AND APPR.
Ⓧ Ⓤ 1018440		1017133	1017134	B1337F	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052A	2	MA1052A	2	MG-5202DC	PRELIMINARY
1018440A		-------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BD	A2704BU	2415 (350)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		-------		-------		MG-6619RV	PRELIMINARY
Ⓤ 1018440B		1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L M2052AA MA103G	B2451B		M2089F	2	M2089AG	2	DD-514V	PRELIMINARY
□ 1018440C		1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L M2052AA MA103G	B2451B		M2089Y	1	M2089F	3	DD-516V	PRELIMINARY
Ⓤ 1018440D		1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L M2052AA MA103G	B2451B		M2089F	2	M2089AG	2	DD-514V	PRELIMINARY
□ 1018440E		1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L M2052AA MA103G	B2451B		M2089Y	1	M2089F	3	DD-516V	PRELIMINARY
Ⓤ 1018440F		1017133A	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	PRELIMINARY
Ⓤ 1018440G		1017133A	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	PRELIMINARY
Ⓣ Ⓗ Ⓐ 1018440H	41175	1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	11-11-99 ALC/DAS
Ⓣ Ⓗ Ⓐ 1018440J	41176	1017583	1017569	1017613	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	11-11-99 ALC/DAS
Ⓤ 1018440K		1017133A	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	--------	A2707AD		1585 (230)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052B	2	MA1052B	2	MG-5114	PRELIMINARY
Ⓤ 1018440L		1017133A	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	--------	A2707AD		1585 (230)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		MA1052B	2	MA1052B	2	MG-5114	PRELIMINARY
Ⓐ 1018440M	41213	--------	1017383	-------	1018688	NO	2	XM2759FM	24 VDC	--------	A2702BC A2707AX	A2704BU	2415 (350)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		------		------		MG-6984 61242	1-25-00 ALC/DAS
Ⓣ Ⓗ Ⓐ 1018440N		1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	0				2	MG-5600DR	PRELIMINARY
Ⓤ Ⓚ 1018440P	41169	1018584	1018594	B3117A	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	M1732AH	2	M1732AH	2	MG-540	11-4-98 DAS/BJE
1018440Q		--------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	--------	A2702BC A2707AX	A2707BD A2704BU	2655 (385)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B		------		------		MG-6449	11-4-98 DAS/BJE
Ⓑ 1018440R		--------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	--------	A2702BC A2707AX	A2704BU	2550 (370)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	3	------		------		MG-6557	11-4-98 DAS/BJE
1018440S		--------	1017383	-------	1017179	NO	2	XM2759FM	24 VDC	--------	A2702BC A2707AX	A2704BU	2450 (355)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6600 MG-6619	11-4-98 DAS/BJE
Ⓧ Ⓤ Ⓞ Ⓚ 1018440T	41164	--------	1017134	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5205DC	6-24-99 ALC/DAS
Ⓧ Ⓤ 1018440U	41132	1017133	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5204SC	9-16-99 ALC/DAS
1018440V	41153	--------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	--------	A2702BC A2707AX	A2707BD A2704BU	2415 (350)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6848SC	11/19/99 ALC/DAS
Ⓨ Ⓤ Ⓟ 1018440W	41178	--------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-516	11/19/99 ALC/DAS
Ⓚ 1018440X	41177	--------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6650SC	1/18/00 ALC/DAS
1018440Y	41253	--------	-------	-------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-520-1HP	2/16/00 ALC/DAS
Ⓤ 1018440Z	41252	--------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-520-1HP	2/16/00 ALC/DAS
Ⓤ 1018440AA	41302	--------	-------	-------	1017179	NO	2	XM2759FM	24 VDC	--------	A2707AD	A2703BA	1860 (270)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5141SC	3/21/00 ALC/DAS
Ⓤ 1018440AB	41303	--------	-------	-------	1017179	NO	2	XM2759FL	12 VDC	--------	A2707AD	A2703BA	1860 (270)	1017129A	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5141SC	3/21/00 ALC/DAS
1018440AC	41309	--------	-------	-------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA103BE(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6650SC	3/21/00 ALC/DAS
1018440AD																							
1018440AE																							
1018440AF																							
1018440AG																							
1018440AH																							
1018440AJ																							
1018440AK																							

NOTE:
INSTALL USING MA908 (LOCTITE #242). THREAD DOG POINT INTO DETENT GROOVE UNTIL SNUG. BACK-OFF 1/2 TURN.

THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.

SETSCREW - M2038W

SPRING - A2702BQ (2) (HYDRAULIC LOCK ONLY)

SPOOL - 1017432 (2) (HYDRAULIC LOCK ONLY)

PISTON - SEE CHART Ⓒ

PIN - A2711AC (2) (HYDRAULIC LOCK ONLY)

PLUG - MA1038E (2)

RACE - M2086DF

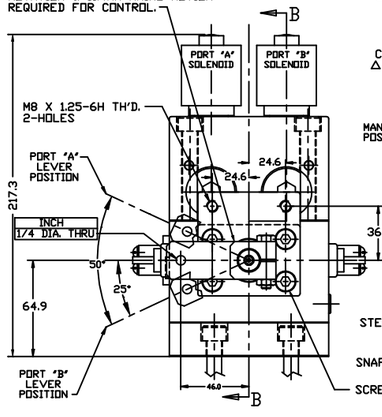
Ⓨ BEARING - M2087AD

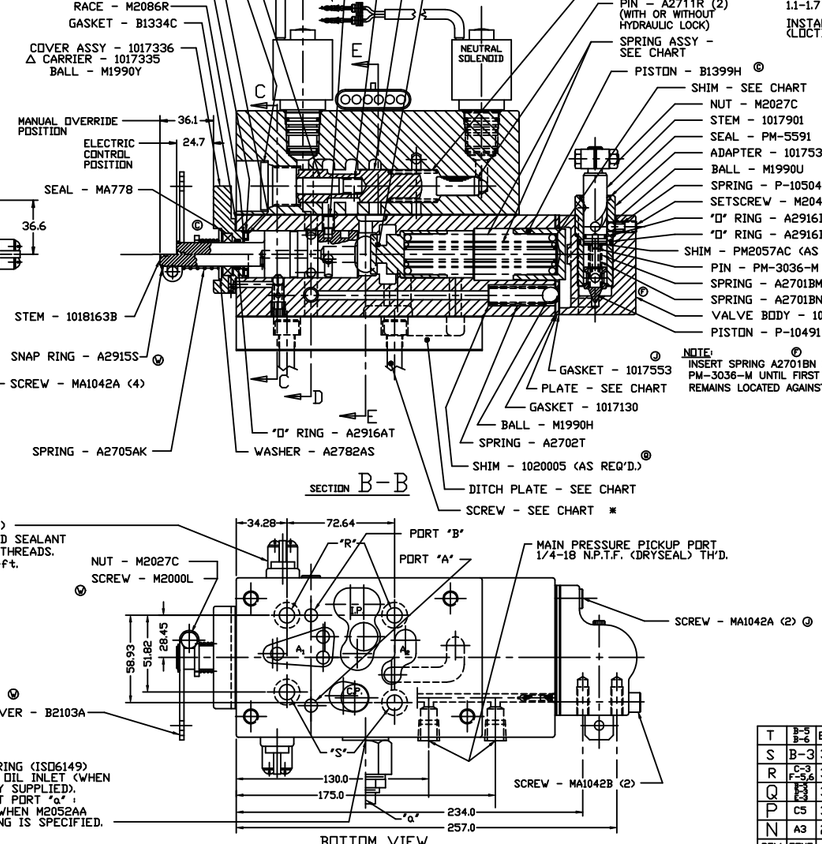
RACE - M2086R

GASKET - B1334C

COVER ASSY - 1017336
△ CARRIER - 1017335
BALL - M1990Y

NOTE:
LEVER MAY BE LOCATED ANYWHERE ON ITS SHAFT THAT PERMITS FREE MOVEMENT WITHIN THE 50° (TOTAL) ROTATION & 11.4mm AXIAL MOTION REQUIRED FOR CONTROL.

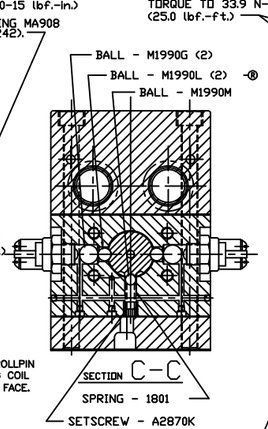




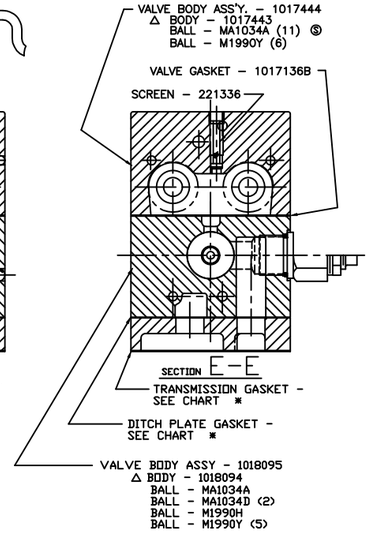
SECTION B-B

Ⓕ NOTE:
INSERT SPRING A2701BN OVER ROLLPIN PM-3036-M UNTIL FIRST SPRING COIL REMAINS LOCATED AGAINST STEM FACE.

NOTE:
ADJUST SETSCREW SO THAT Ⓓ THE TORQUE REQUIRED TO OVERCOME DETENT IS 1.1-1.7 Nm (10-15 lbf.-in.)
INSTALL USING MA908 (LOCTITE #242).

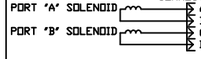


NOTE:
INSTALL USING MA908 (LOCTITE #242) TOP OF SCREW MUST BE FLUSH WITH SURFACE.

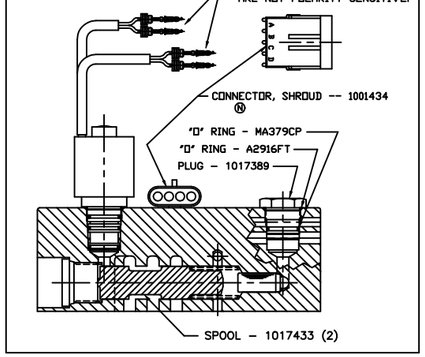

VALVE BODY ASS'Y. - 1017444
△ BODY - 1017443
BALL - MA1034A (11) Ⓢ
BALL - M1990Y (6)
VALVE GASKET - 1017136B
SCREEN - 221336
SECTION E-E
TRANSMISSION GASKET - SEE CHART ⋇
DITCH PLATE GASKET - SEE CHART ⋇
VALVE BODY ASS'Y - 1018095
△ BODY - 1018094
BALL - MA1034A
BALL - MA1034D (2)
BALL - M1990H
BALL - M1990Y (5)

PARTS FOR UNITS WITHOUT NEUTRAL SOLENOID AND HYDRAULIC LOCK (OPTIONAL CONDITION)

WIRING DIAGRAM:



OPTIONAL:
MATING WIRING HARNESS 1017404 SERIES (SPECIFY LENGTH).


THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.
CONNECTOR, SHROUD -- 1001434 Ⓝ
"O" RING - MA379CP
"O" RING - A2916FT
PLUG - 1017389
SPOOL - 1017433 (2)

BOTTOM VIEW

X - STR. TH'D. "O" RING (ISO6149) MAIN PRESSURE OIL INLET (WHEN NOT INTERNALLY SUPPLIED). THREAD SIZE AT PORT "A" & 1/4-18 N.P.T.F. WHEN M2052AA REDUCER BUSHING IS SPECIFIED.

Ⓒ

Ⓥ □ OBSOLETE FOR PRODUCTION AND SERVICE

△ NOT SERVICEABLE SEPARATELY

⋇ THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
T	B-5 B-6	ECN10020	3-16-01				
S	B-3	30568	2-06-01	Y		ECN10415	1-11-02
R	C-3 F-5,6	30462	11-16-00	X		ECN10465	10-26-01
Q		30289	8-30-00	W	F2	ECN10249	6-20-01
P	C5	30015	4-12-00	V	B1	ECN10055	4-18-01
N	A3	29954	3-22-00	U		ECN10054	4-18-01

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MATERIAL: ----------
HEAT TREAT: ----------
SURFACE TREATMENT:
WEIGHT kg / Wt lb
FIRST USE ASSY. 1015207 MODEL MG-5202DC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 10-12-98
SCALE .50 = 1.00
DRN. RM
CHK. BE
APPD. DAS
NAME VALVE ASS'Y. - CONTROL (WITH TROLLING VALVE)

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1018440 SERIES

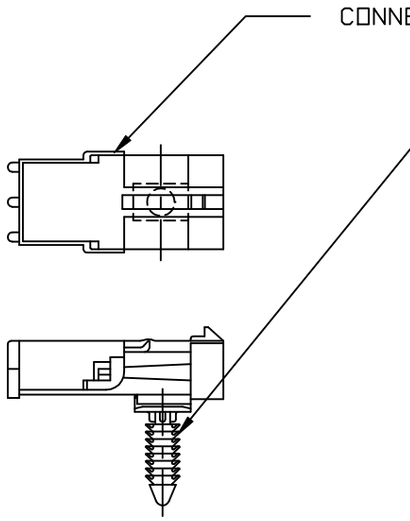
HYDRAULIC DIAGRAM A7119W, SHEET 3 OF 3

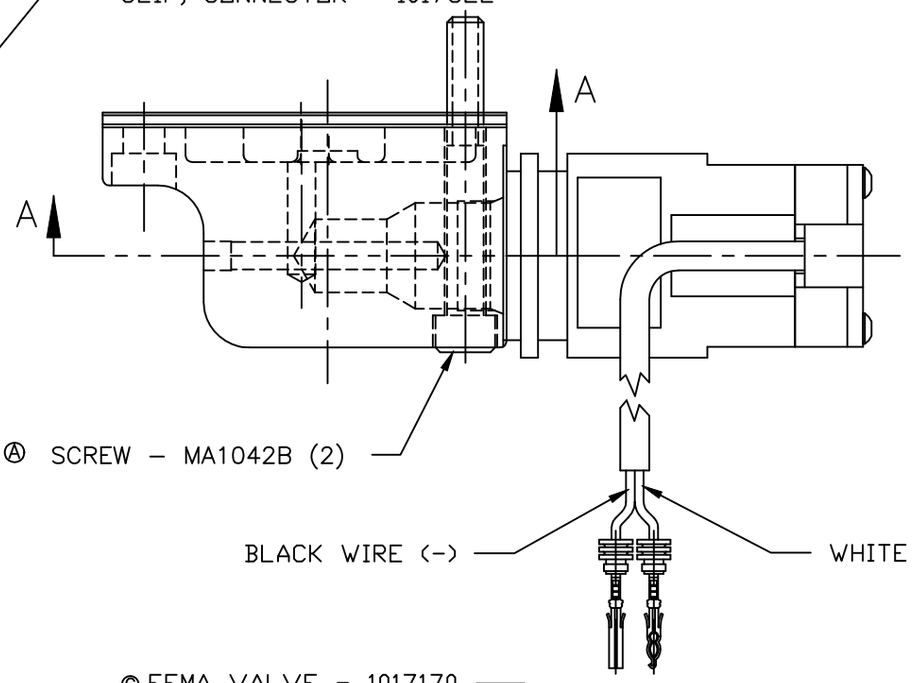
METRIC

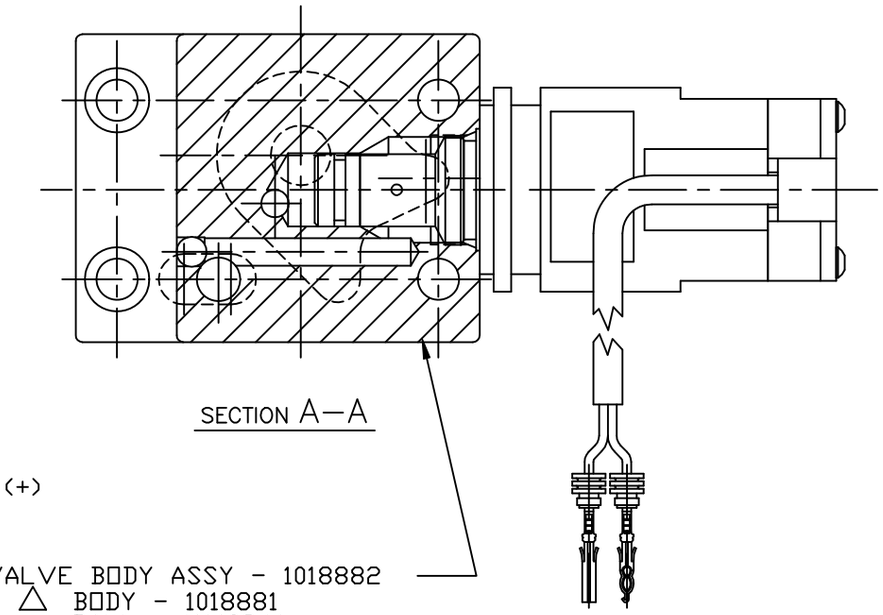
THIRD ANGLE PROJECTION

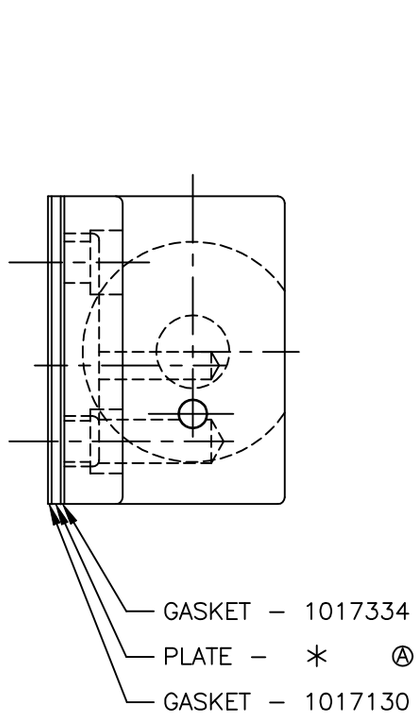
SIMILAR TO

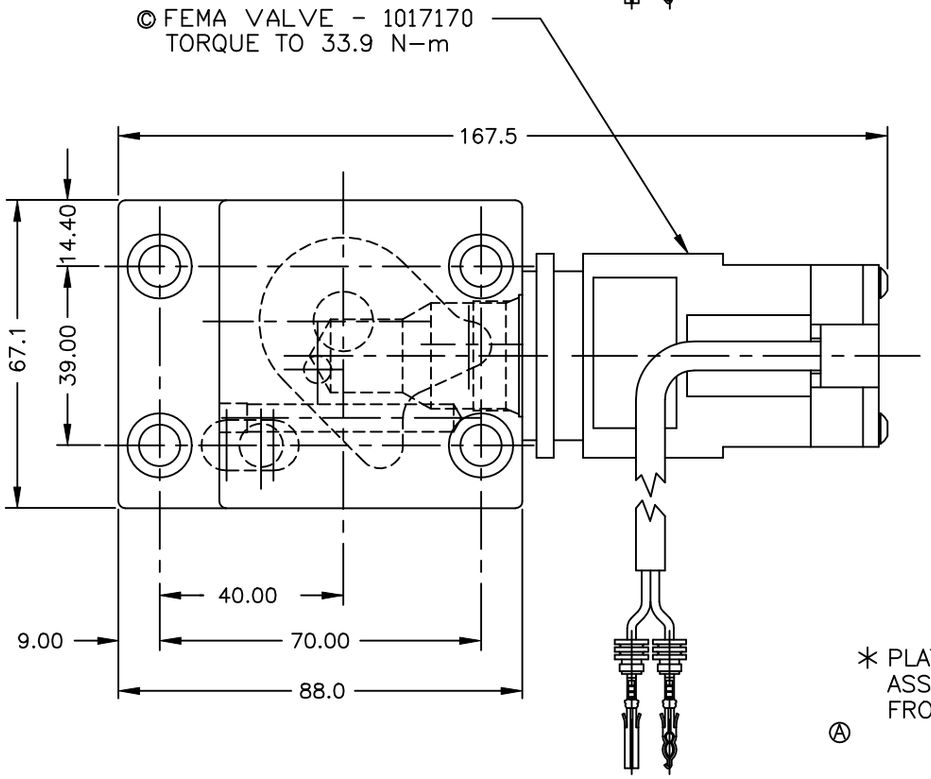
SHEET 1 OF 1 REV Y

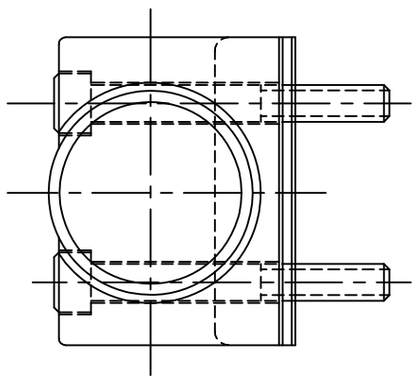












* PLATE IS NOT INCLUDED IN ASSEMBLY. USE EXISTING PLATE FROM CONTROL VALVE.

Ⓐ

△ NOT SERVICEABLE SEPARATELY

Ⓐ BOM No. – 41063

REV	ZONE	CH. NO.	DATE
C	C–3	29641	10–8–99
B	A–1	29503	8–20–99
A	B–1 C–1 D–1	29350	6–24–99

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg | WR² N·m²

FIRST USE
ASSY. 1015207
MODEL MG–5202DC

NAME
Ⓑ VALVE ASS'Y., TROLLING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

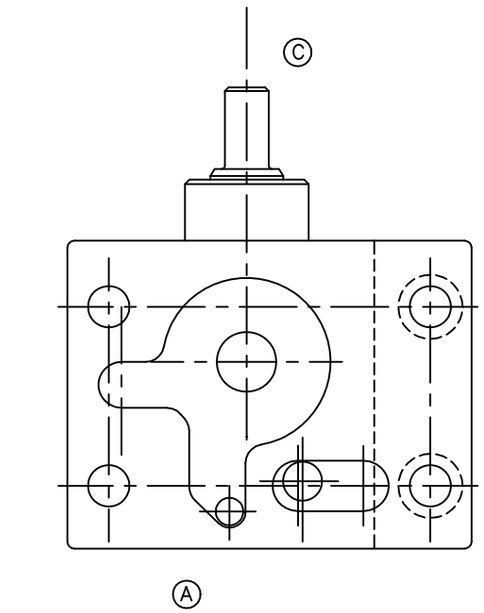
DATE 3–19–99
SCALE 1.0=1.0
DRN. RM
CHK. BJE
APPD. DAS

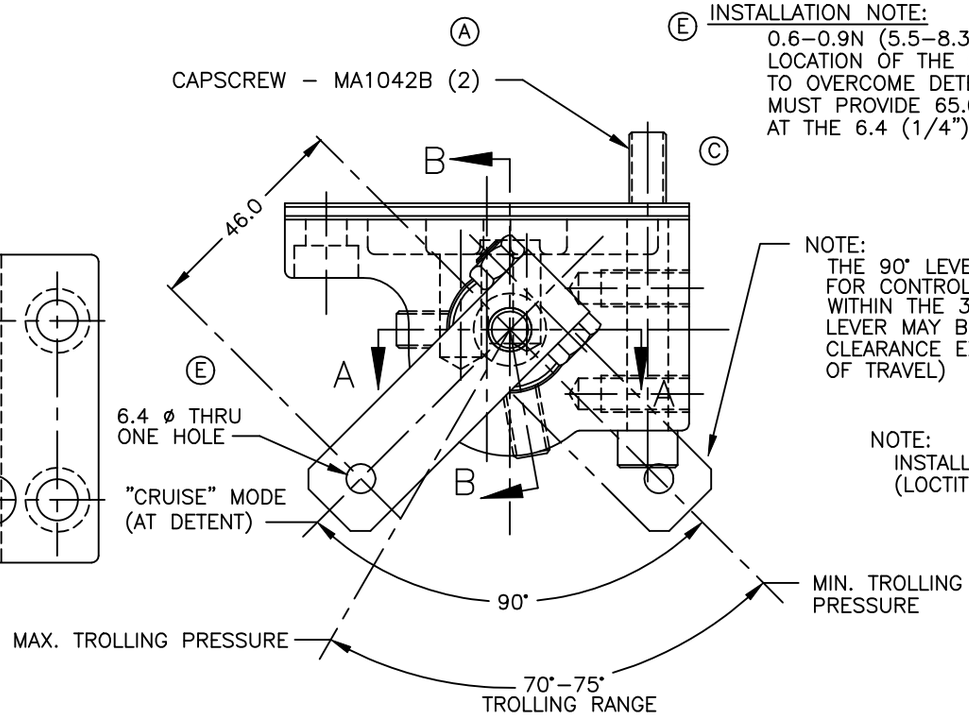
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO
1017554
PX–8671

TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

1018883

SHEET 1 OF 1 REV C

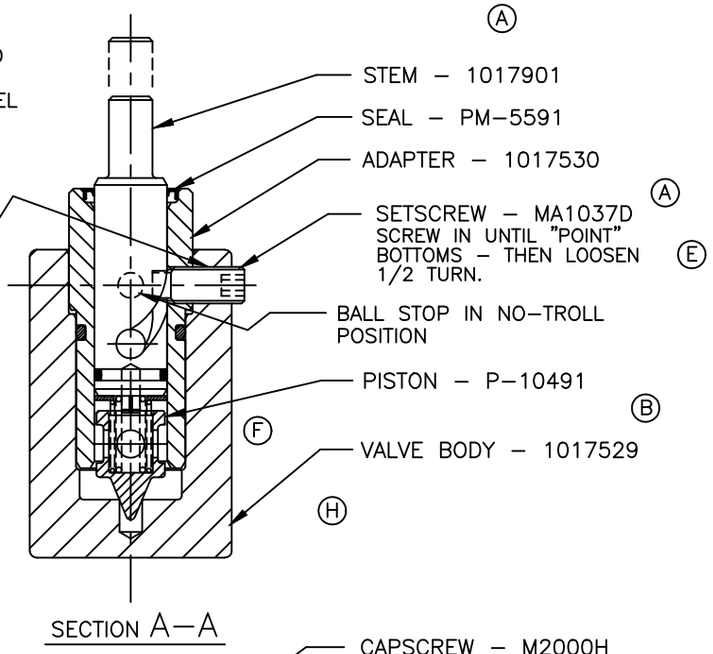




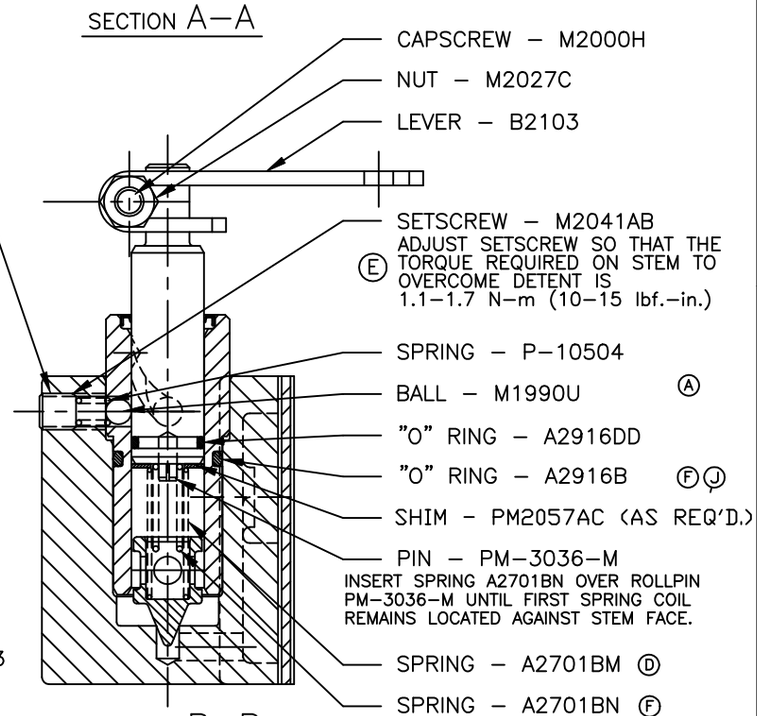
Ⓔ INSTALLATION NOTE:
0.6–0.9N (5.5–8.3 lb.) AT THE 46.0 (1.81") R LOCATION OF THE 6.4 (1/4") DIA. HOLE IS REQUIRED TO OVERCOME DETENT. REMOTE CONTROL ACTUATOR MUST PROVIDE 65.0 mm (2.56") TOTAL LINEAR TRAVEL AT THE 6.4 (1/4") DIA. HOLE LOCATION.

NOTE:
THE 90° LEVER ROTATION REQUIRED FOR CONTROL MAY FALL ANYWHERE WITHIN THE 360° IN WHICH THE LEVER MAY BE CLAMPED. (PROVIDED CLEARANCE EXISTS FOR FULL 90° OF TRAVEL)

NOTE:
INSTALL USING MA908
(LOCTITE #242).

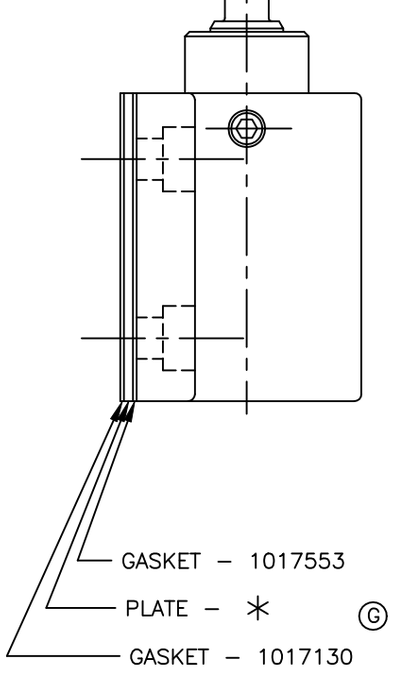


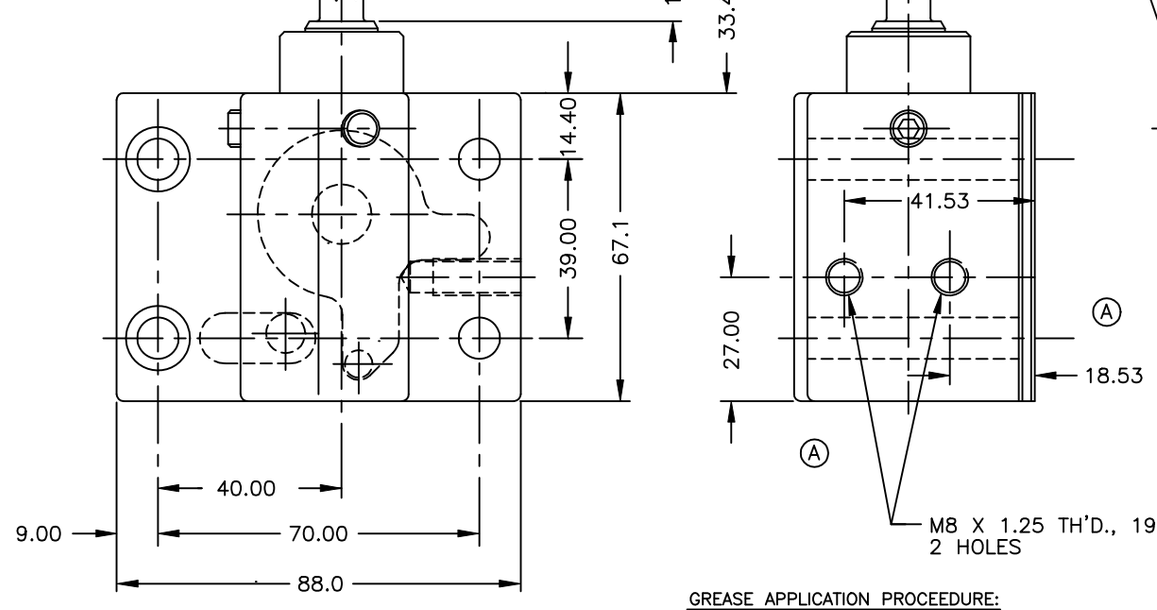
SECTION A–A



SECTION B–B

Ⓖ BOM NO. 40588





Ⓖ ✳ PLATE IS NOT INCLUDED IN ASSEMBLY.
USE EXISTING PLATE FROM CONTROL VALVE.

GREASE APPLICATION PROCEEDURE:

BEFORE INSTALLING VALVE STEM INTO BODY APPLY GENERAL PURPOSE GREASE PER S–364, ITEM 6, NO. 1 NLGI CONSISTENCY TO THE VALVE STEM FROM THE "O" RING GROOVE TO NECKED–DOWN DIAMETER AT LEVER END.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

PX–8671

REV	ZONE	CH. NO.	DATE
J	A–2	30289	8–30–00
H	A–3	29863	1–31–00
G	C,D $^{-1}$ A–1	29350	6–24–99
F	A–1,–2 A–3,–4	29117	2–4–99
E	A–3,–4 B–4	29015	12–17–98
D	A–2	28585	6–3–98
C	ALL	28500	4–20–98
B	A–4	28315	1–21–98
A	ALL	28208	11–26–97

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RACINE, WI 53403 – USA
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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg | WR² N·m²

FIRST USE
Ⓒ ASSY. 1017546
MODEL VARIOUS

NAME
VALVE ASS'Y., TROLLING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

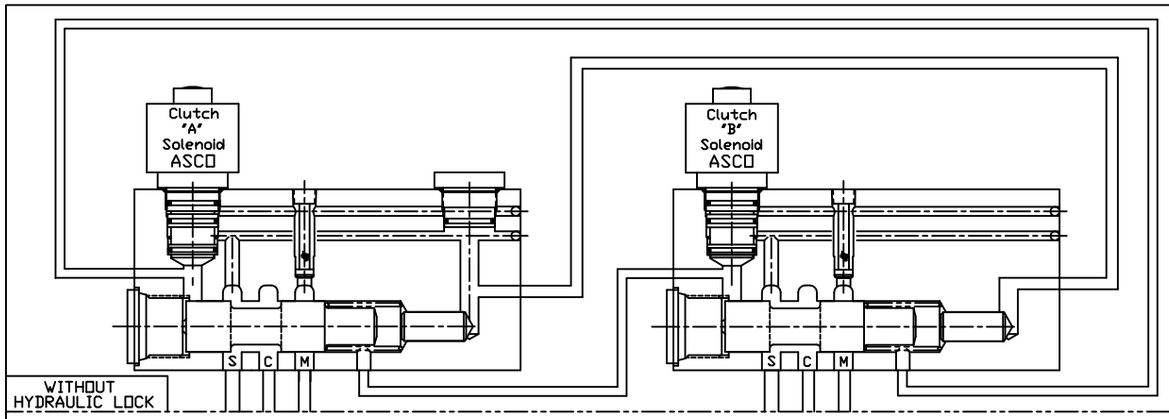
DATE 7–30–97
SCALE 1.0=1.0
DRN. RM
CHK. BE
APPD. BE

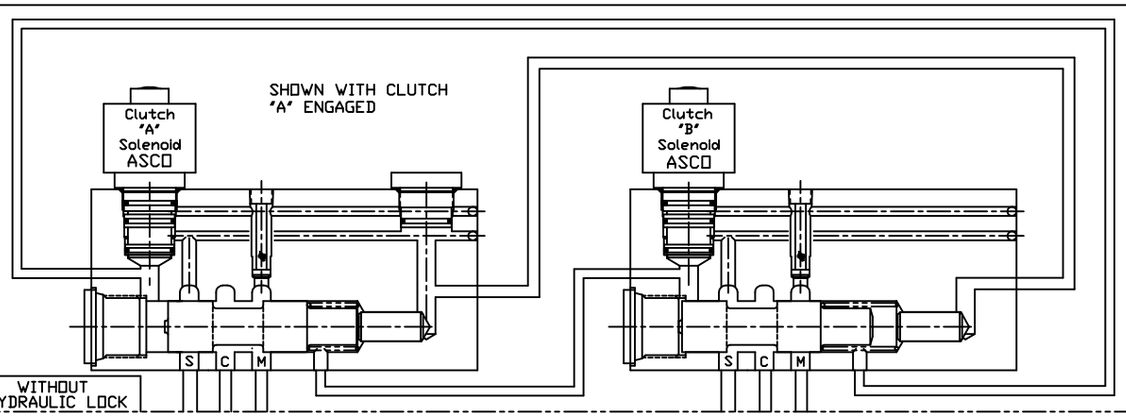
TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

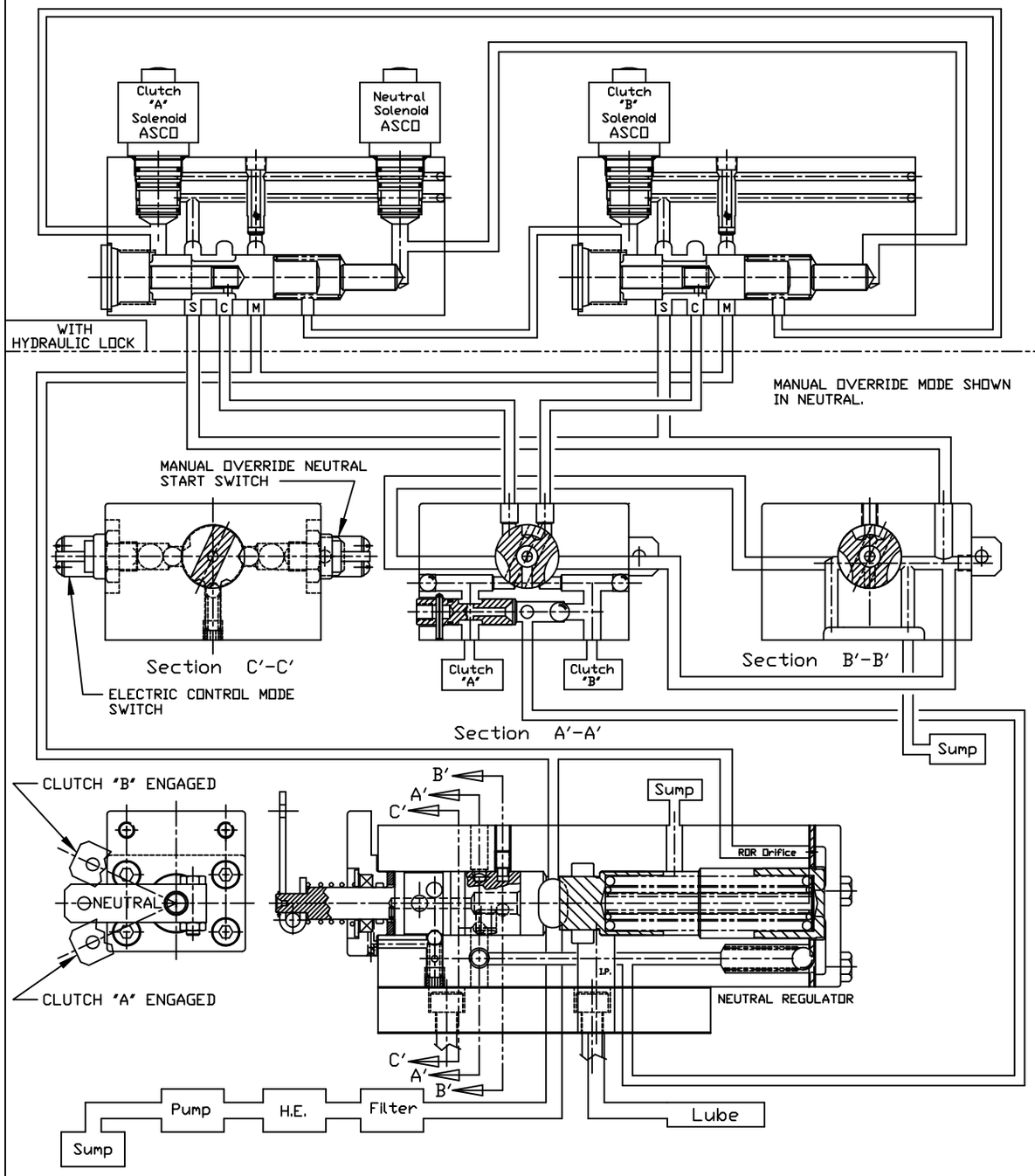
1017555

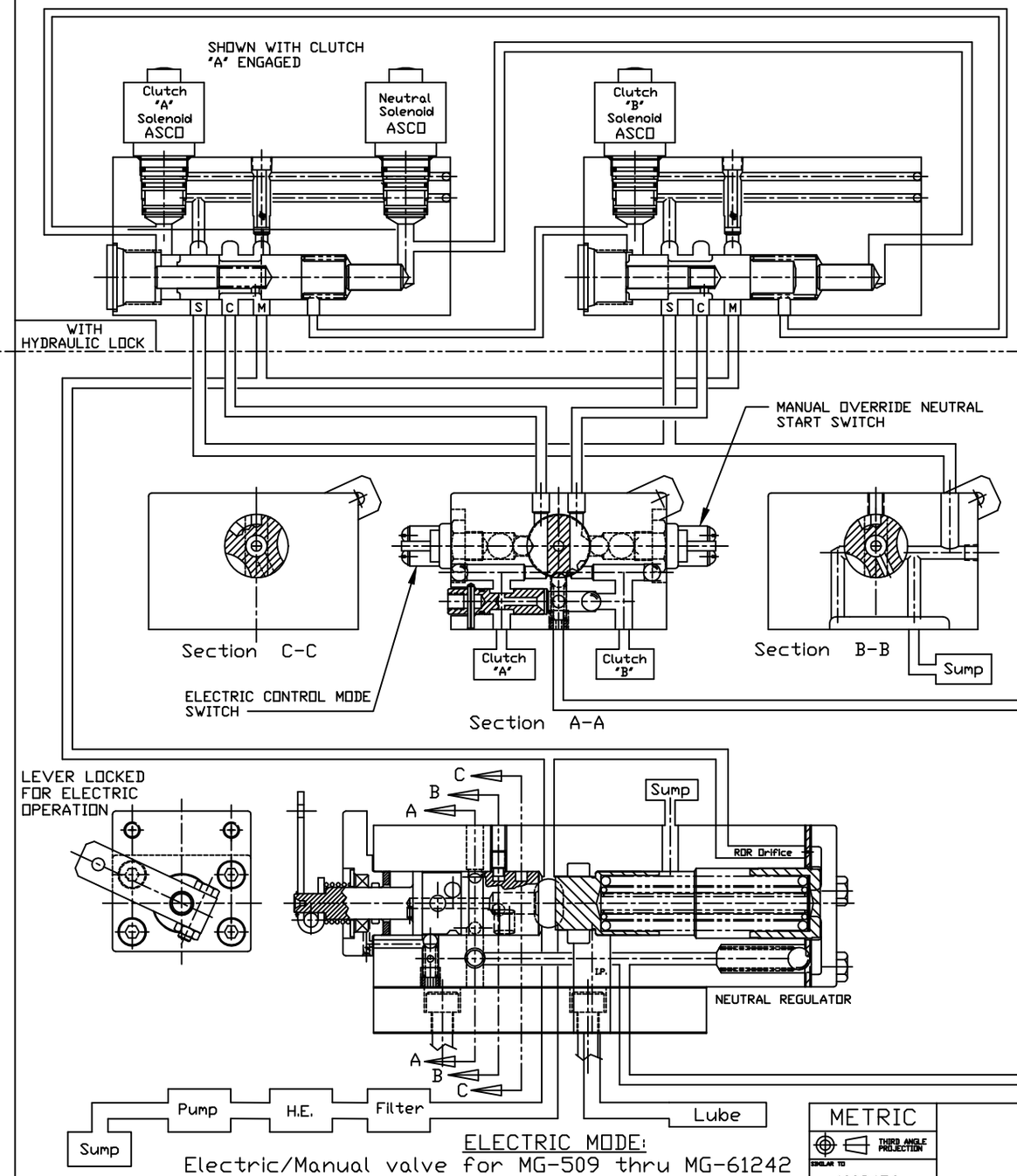
SHEET 1 OF 1 | REV J

D C B A









MANUAL MODE: ELECTRIC/MANUAL VALVE FOR MG-509 THRU MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018084)

ELECTRIC MODE:
Electric/Manual valve for MG-509 thru MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018084)

C = CLUTCH APPLY
I.P. = INTERMEDIATE PRESS. (LUBE)
M = MAIN PRESS.
S = SUMP

SHEET	REV	ZONE	CH. NO.	DATE
3	A		29314	4-27-99

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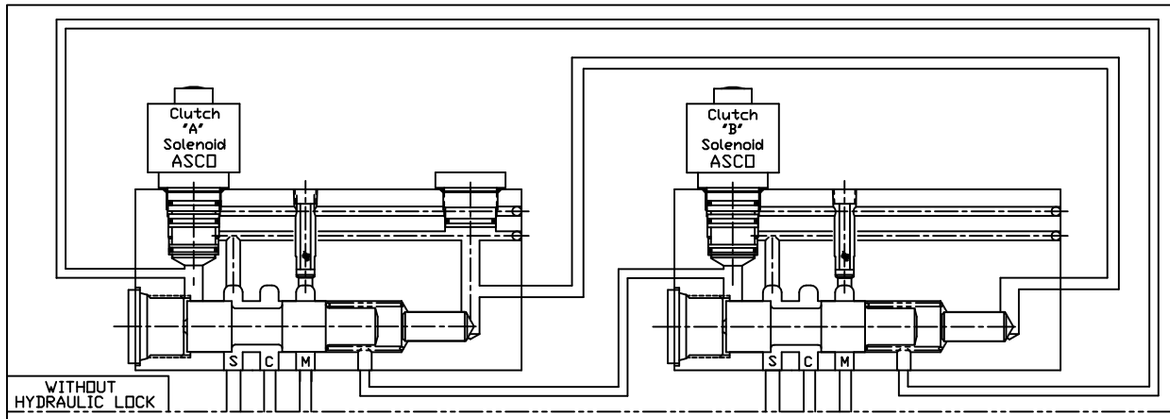
MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT
FIRST USE
ASSY.
MODEL
NAME: DIAGRAM, HYDRAULIC (WITHOUT TROLLING VALVE)

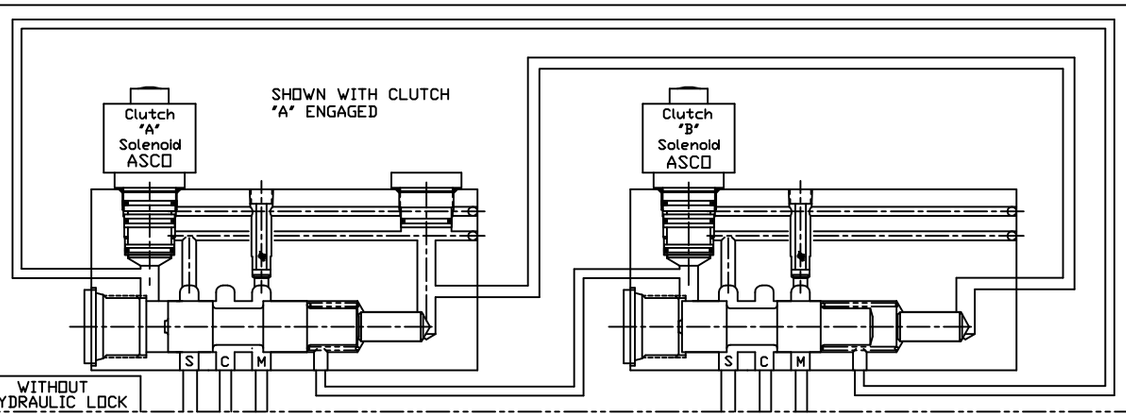
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.76
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

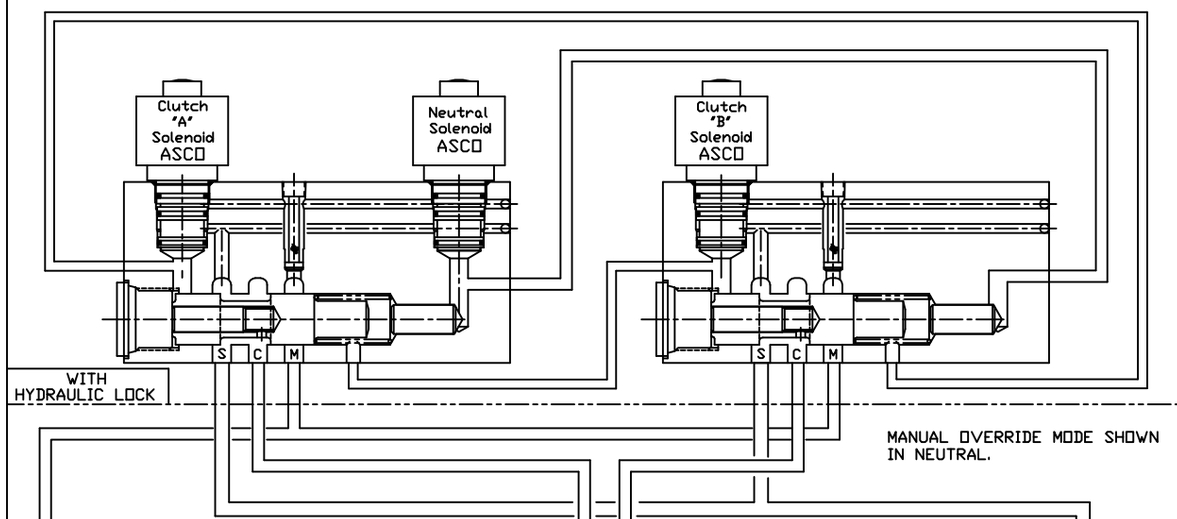
DATE: 3-30-98
SCALE: 1.00 = 1.00
DRN. RM
CHK. B.J.E.
APPR. DAS

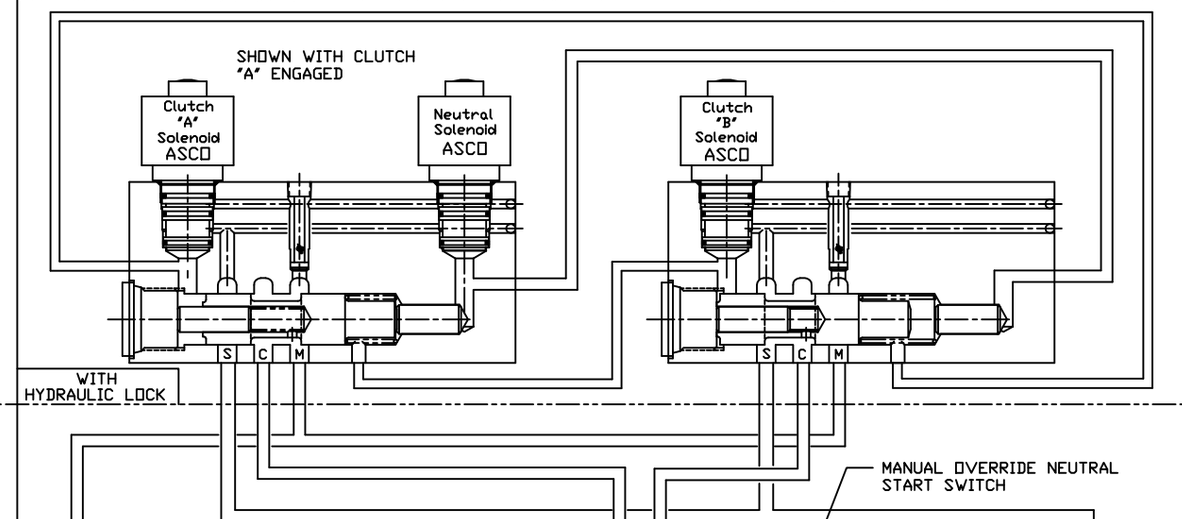
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1002456

TWIN DISC INCORPORATED RACINE, WI 53403 - USA
A7119W
SHEET 1 OF 3 REV A









MANUAL MODE: ELECTRIC/MANUAL VALVE FOR MG-509 THRU MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018085)

ELECTRIC MODE:
Electric/Manual valve for MG-509 thru MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018085)

C = CLUTCH APPLY
I.P. = INTERMEDIATE PRESS. (LUBE)
M = MAIN PRESS.
S = SUMP

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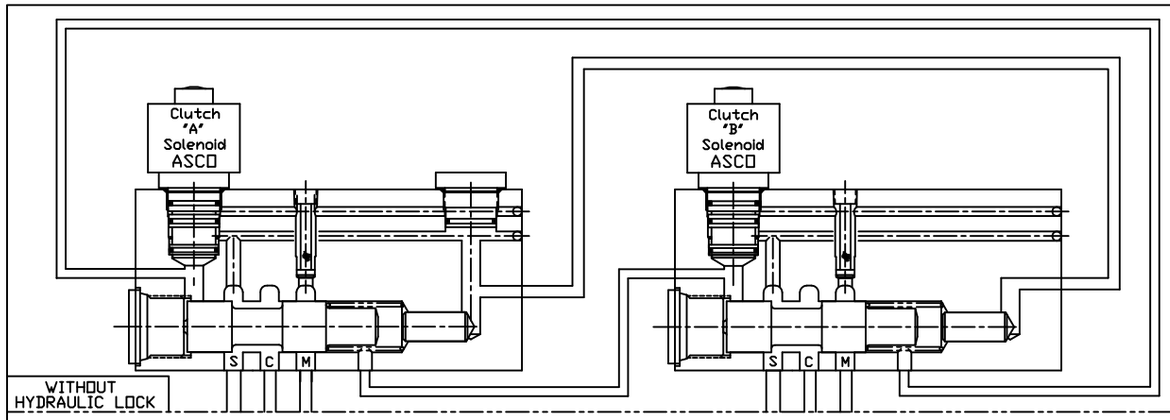
MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.76
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 3-30-98
SCALE 1.00 = 1.00
DRN. RM
CHK. B.JE
APPD. DAS
FIRST USE
ASSY.
MODEL
NAME DIAGRAM, HYDRAULIC (WITH TROLLING VALVE)

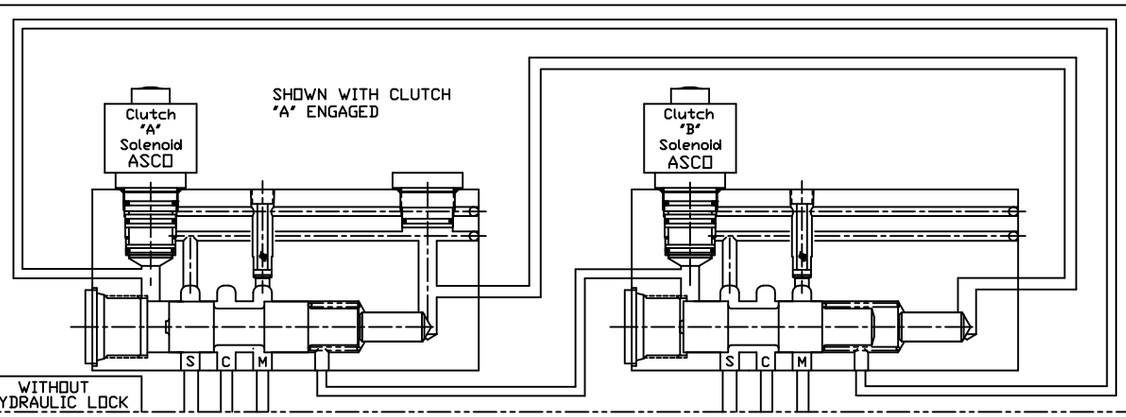
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1002456

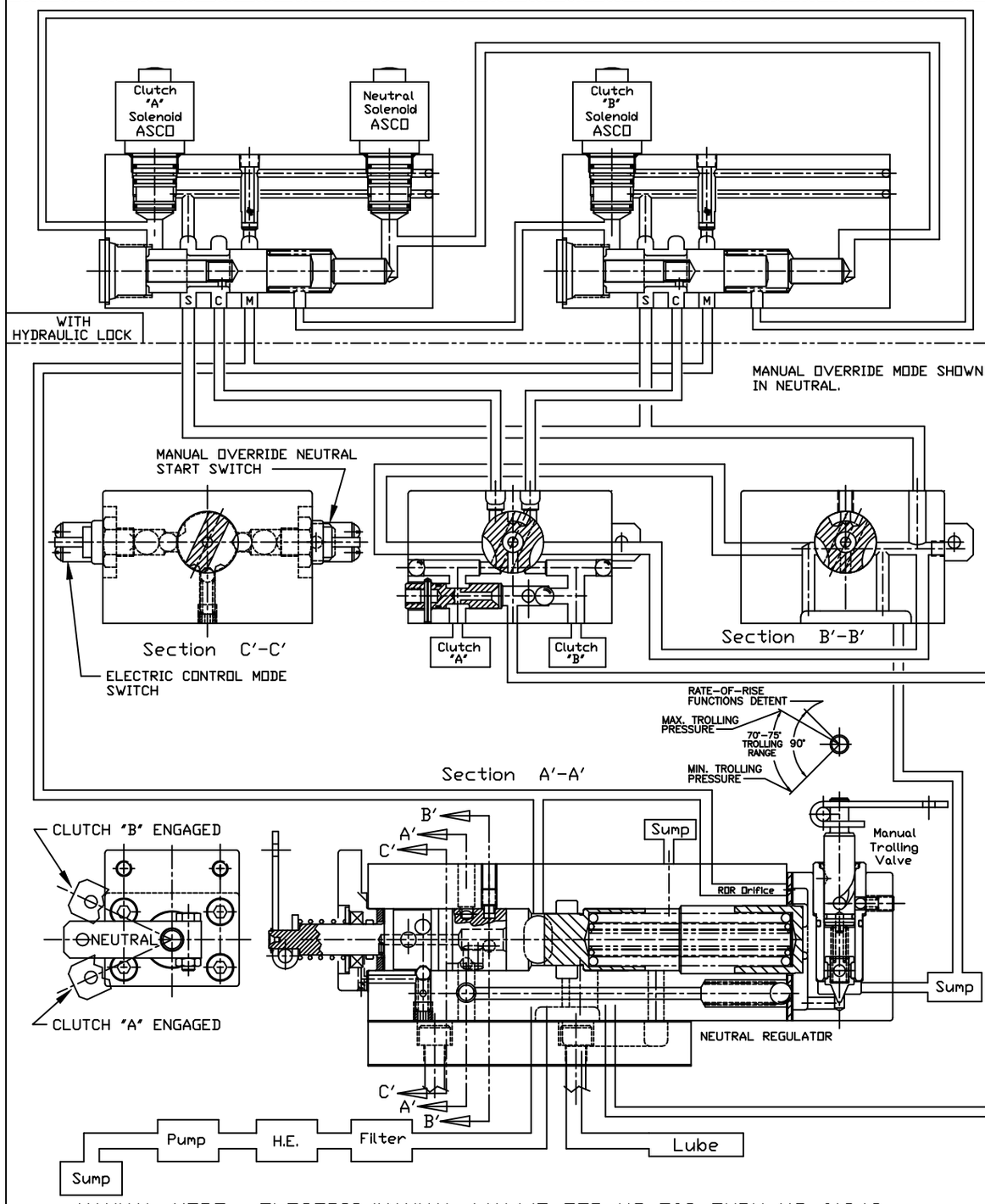
TWIN DISC INCORPORATED RACINE, WI 53403 - USA
A7119W
SHEET 2 OF 3 REV A

E D C B A

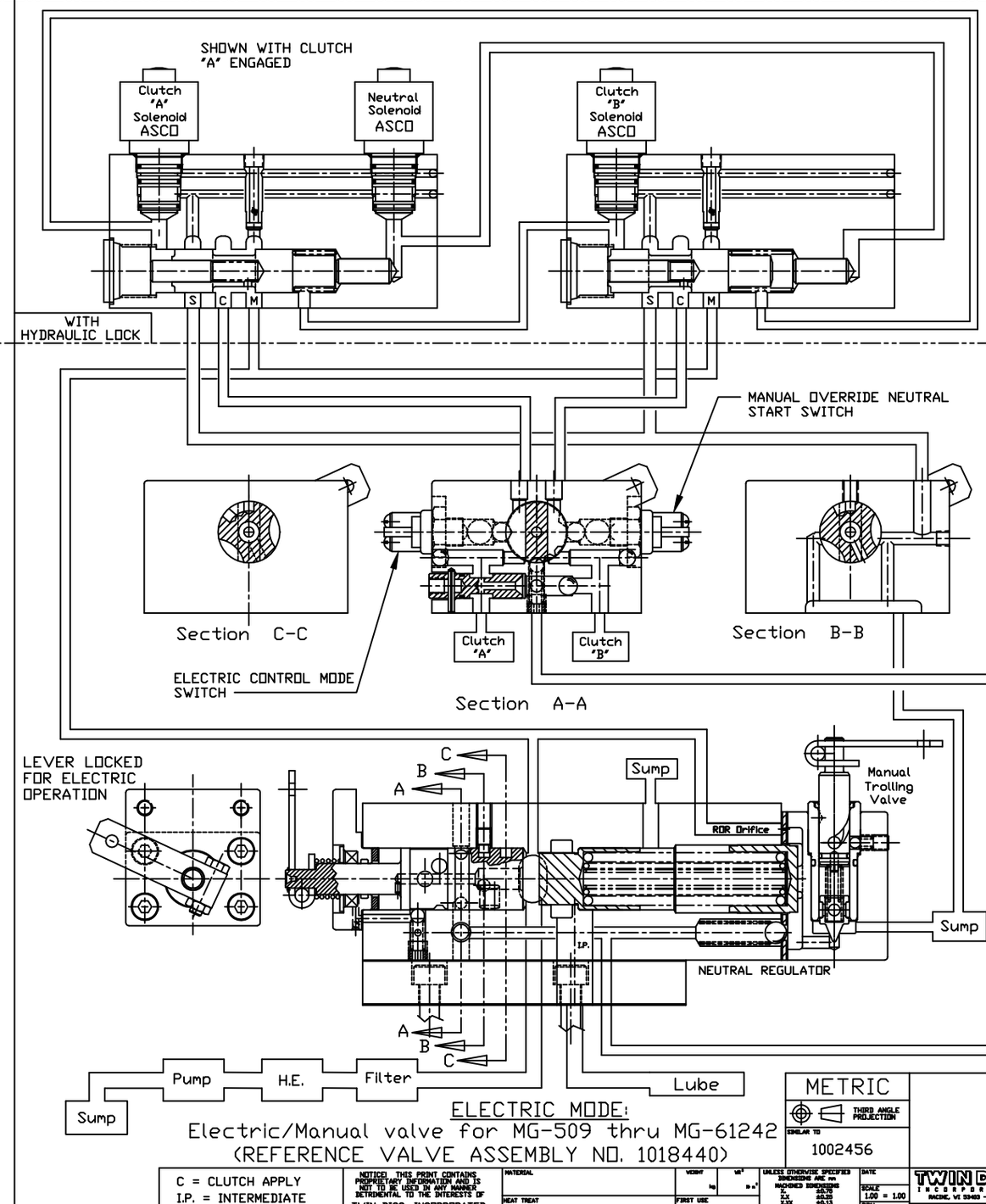
6 5 4 3 2 1







MANUAL MODE: ELECTRIC/MANUAL VALVE FOR MG-509 THRU MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018440)



ELECTRIC MODE:
Electric/Manual valve for MG-509 thru MG-61242
(REFERENCE VALVE ASSEMBLY NO. 1018440)

C = CLUTCH APPLY
I.P. = INTERMEDIATE PRESS. (LUBE)
M = MAIN PRESS.
S = SUMP

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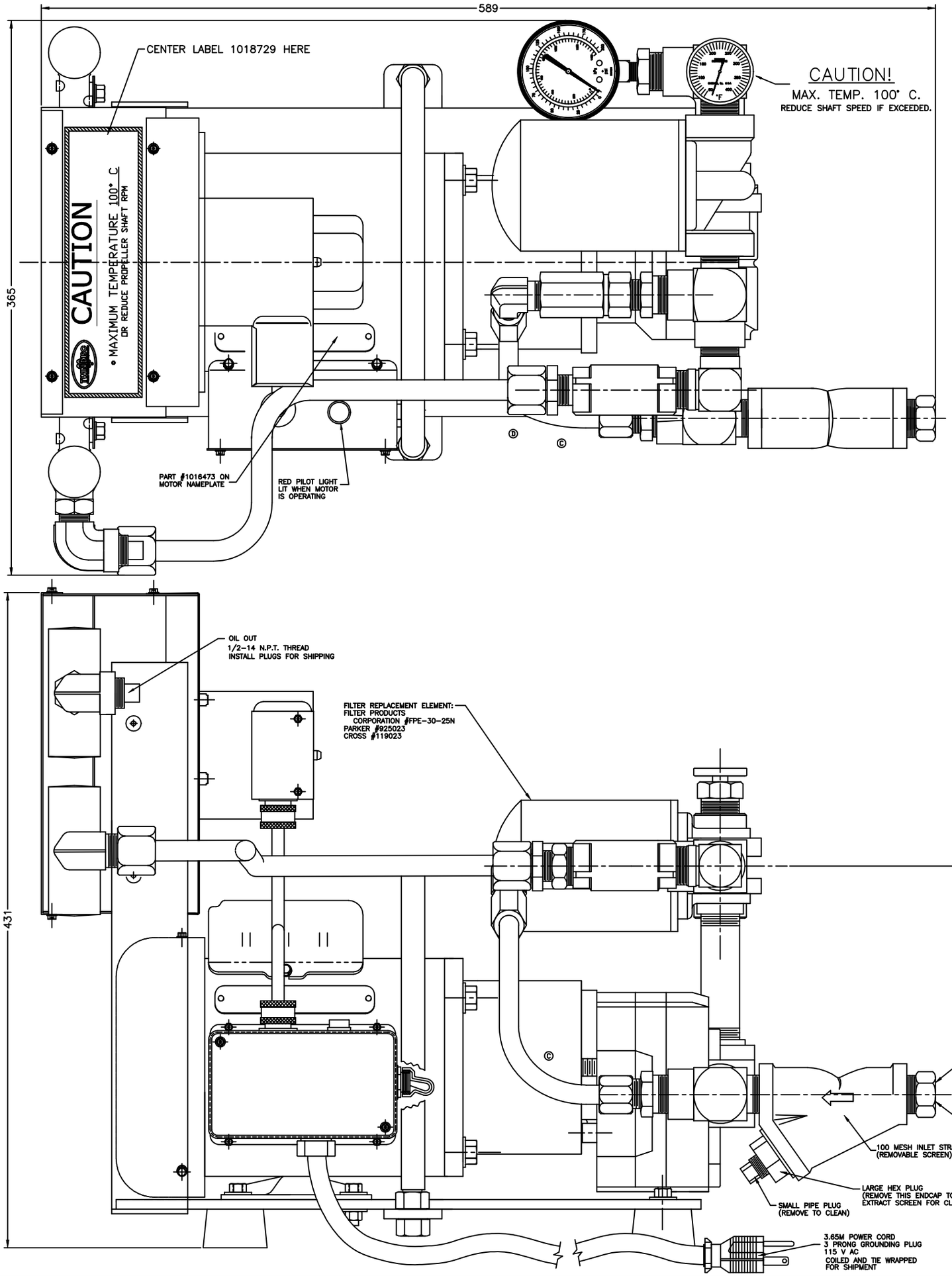
MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.76
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° DIMENSIONING PER ANSI Y14.5M 1982
FIRST USE
ASSY.
MODEL
NAME
DIAGRAM, HYDRAULIC (WITH TROLLING VALVE)

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1002456

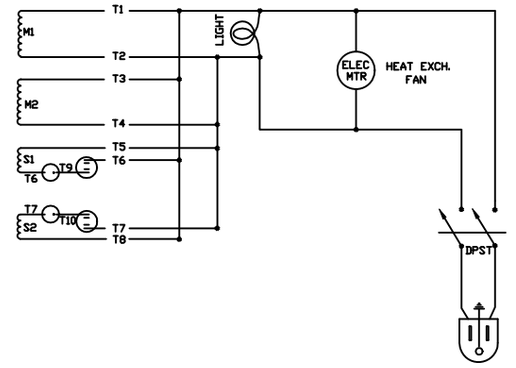
DATE 1.00 = 1.00
SCALE
DRN. RM
CHK. B.JE
APPD.

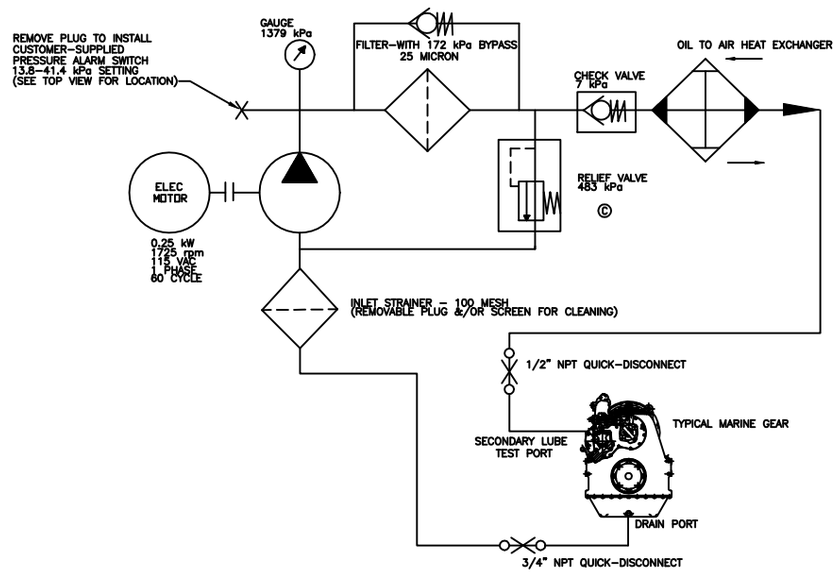
TWIN DISC INCORPORATED RACINE, WI 53403 - USA
A7119W
SHEET 3 OF 3 REV A

E D C B A
6 5 4 3 2 1



SINGLE PHASE, CAPACITOR, TYPE C, THERMALLY PROTECTED, DUAL VOLTAGE, DUAL ROTATION, 8 LEAD




REMOVE PLUG TO INSTALL CUSTOMER-SUPPLIED PRESSURE ALARM SWITCH 13.8-41.4 kPa SETTING (SEE TOP VIEW FOR LOCATION)
GAUGE 1379 kPa
FILTER-WITH 172 kPa BYPASS 25 MICRON
OIL TO AIR HEAT EXCHANGER
CHECK VALVE 7 kPa
ELEC MOTOR
0.25 kW 1725 rpm 115 VAC 1 PHASE 60 CYCLE
RELIEF VALVE 483 kPa
INLET STRAINER - 100 MESH (REMOVABLE PLUG &/OR SCREEN FOR CLEANING)
1/2" NPT QUICK-DISCONNECT
TYPICAL MARINE GEAR
SECONDARY LUBE TEST PORT
DRAIN PORT
3/4" NPT QUICK-DISCONNECT

PUMP FLOW RATE IS 11.0 l/min. AT 102° C.

REV	ZONE	CH. NO.	DATE
D	D-5	29860	1-26-00
C	B	29423	7-6-99
B	A-1	29078	1-19-99
A	---	29003	12-4-98

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METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

B
WEIGHT 27.0 kg
SIZE
FIRST USE
ASSY.
MODEL
NAME PUMP ASSEMBLY (TRAILING)

MATERIAL
HEAT TREAT
SURFACE TREATMENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MACHINED DIMENSIONS
X ±0.50
.XX ±0.25
.XXX ±0.13
ALL ANGULAR TOLERANCES ±1°
DEBURRED TOLERANCING PER ANSI Y14.5M 1982

DATE 6-24-98
SCALE 1:1
DRN. DMB
CHK. PJL
APPD. DAS

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1016473

SHEET 1 OF 1 REV D

#1020538 01/02

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